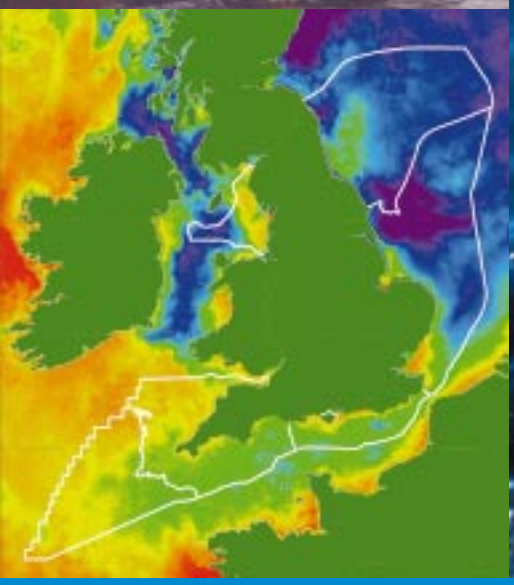
ENGLISH NATURE

The Mid North Sea Marine Natural Area

A contribution to regional planning and management of the seas around England



working today
for nature tomorrow

Foreword

Over the last few years, there has been a greater recognition not only of the need to manage our maritime environment in a more holistic way, but also the ways in which this might be achieved. In their report *Safeguarding our Seas*, Defra (2002a) set out a vision and ideas to address this need, founded on an ecosystem approach. English Nature also set out the case for such an approach in its *Maritime State of Nature* report (Covey & Laffoley 2002). Both documents emphasise that we need to take a more integrated approach to managing human activities in order to restore and maintain healthy ecosystems. This will benefit both present and future generations. The UK Government's commitment to developing this approach is reflected in various European and international statements such as the output of the World Summit on Sustainable Development. The challenge now is how to put the ecosystem approach into practice. The Marine Natural Areas concept and the information set out in this document is a positive step forward in meeting this challenge.

English Nature initially conceived the idea of 'Natural Areas' on land and in the nearshore zone. They were identified on the basis of their underlying geology, natural systems and physical processes. As wildlife is not restricted to designated sites, Natural Areas provide an essential context that help us to manage specific sites better. They also help us to understand the nature conservation value of the wider countryside. Natural Areas provide a strategic framework for English Nature, in consultation with stakeholders, to set objectives at a broad scale, to plan action and resources to achieve these, and to bring partners on board. It was a logical step to extend the concept into the marine environment. So, English Nature has identified and described, together with the Joint Nature Conservation Committee and in consultation with other organisations, six Marine Natural Areas. Though the boundaries of the Marine Natural Areas reflect a number of natural factors, the boundaries only encompass the seas around England, not other parts of the UK. However, we hope that the approach set out here, together with initiatives such as the Review of Marine Nature Conservation's Irish Sea Pilot project, will help catalyse a more comprehensive approach to regional seas that incorporates areas of sea beyond England's borders.

Marine Natural Areas take account of natural processes and the interaction between them, the underlying geology and wildlife. They offer a biogeographic framework within which we can develop and implement an ecosystem approach to managing human uses of the marine environment. The information contained within this report provides advice on the nature conservation value of large areas of sea. It also outlines our knowledge of where natural features are and the context this provides for a variety of human uses. This information should continue to be updated and refined. Such spatial data is essential if we are to consider tools such as sea use planning for the range of activities that occur in the marine environment.

We need a healthy, resilient marine environment supporting biodiversity and a variety of sustainable economic uses. That requires new ideas and initiatives and as such we commend this report as a contribution to the debate about how best to achieve this.

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1 Introduction

1.1 Definition and role of Marine Natural Areas

Marine Natural Areas are areas of sea around England that have been identified using oceanographic processes, bathymetry and biogeographic characteristics to define broad natural divisions in the marine environment. Marine Natural Areas seek to identify ecologically relevant boundaries at a broad scale for which ecologically relevant objectives and targets can then be identified. Like Natural Areas identified in the terrestrial and nearshore environment[1], Marine Natural Areas emphasise the importance of natural processes, the interaction between these, geology, and wildlife. We have identified six Marine Natural Areas, as explained below.

Natural Areas offer a biogeographic framework within which to develop and implement an ecosystem approach to managing human activities (see Appendix 1) and to securing a sustainable future for the marine environment. However, we recognise that the basis of 'regional seas' is likely to evolve as interest in a regional approach to the marine environment gathers momentum. This is especially so in relation to Scotland, Wales and the Irish Sea, as the boundaries of our Natural Areas are currently restricted to England.

We hope that the Marine Natural Areas and the information presented in this document will be of use to those interested or involved in the stewardship of our seas. This includes those responsible for planning, regulating or managing human activities, other agencies, local, regional and national Government and the wider public. In particular, we hope that the Marine Natural Areas:

- provide an ecological rationale for defining broad regional units;
- suggest an appropriate scale and potential framework in which to manage and govern the seas adjacent to England;
- provide information on habitats and species, physical features and nature conservation importance across the wider marine environment, and the key human activities relevant to these;
- complement or assist other initiatives, such as the 'regional seas' approach currently being piloted in the Irish Sea under the Defra-led Review of Marine Nature Conservation[2];
- present information in a structured and easily accessible manner which can be adapted for use by others as required.

English Nature will continue to use and build on Marine Natural Areas, within the context of our developing Maritime Strategy and initiatives led by the Joint Nature Conservation Committee, Government and others. We will use them to:

[1] 120 Natural Areas, including 23 coastal Natural Areas, each identified by distinctive habitats, physical features and species that distinguish it from neighbouring areas. (Profiles for terrestrial and coastal Natural Areas can be found at (www.english-nature.co.uk/Science/natural/NA_search.asp)

[2] The Irish Sea Marine Natural Area is only part of the area covered by the Irish Sea Pilot (ISP). The ISP Project has dealt with some of the issues discussed in the Marine Natural Area profile in much more detail. We have published the Irish Sea Marine Natural Area Profile because it contains some information not considered by the ISP. It also highlights what could be achieved in other regional areas by building on Marine Natural Areas.

- draw up objectives and targets for nature conservation at a regional scale together with key stakeholders and Government;
- promote a strategy and policies for the management of seas around England;
- manage our work and resources to achieve objectives and targets, including those under the UK's Biodiversity Action Plan.

1.2 The basis for Natural Area boundary selection

Marine Natural Areas take account of oceanographic processes, bathymetry and broad biogeographic characteristics. Using these features as a basis for delimiting the individual areas, English Nature explored options with the Joint Nature Conservation Committee to identify the six Marine Natural Areas shown in Figure 1.1.

The boundaries between adjacent Marine Natural Areas are partly based on the 50 metre isobath. This is the approximate depth at which wave action on the seabed (a mechanism for driving sedimentary processes) tends to become of minimal significance. The 50 metre isobath also marks the transition between shallow, well-mixed turbid conditions and deeper, seasonally stratified waters such as that found in the North Sea (Brampton and Evans 1998). This delineation between well-mixed and seasonally stratified water masses is significant in plankton dispersal and therefore in distinguishing between marine biological assemblages (Hiscock 1996). In addition, such transitions sometimes form 'fronts' with associated high biological productivity. For example, the location of seabird breeding colonies may indicate the distribution of important marine feeding grounds at the Flamborough front to the north east of Flamborough Head (Skov *et al* 1995).

Broad biogeographic characteristics were also used to set the boundaries between some of the Marine Natural Areas. In particular, a well established biogeographical transition has been used to derive the boundary between the English Channel and South Western Peninsula Natural Areas. The transition occurs between the relatively warmer Boreal-Lusitanean region to the west and colder Boreal region to the east. Such a transition has a marked influence on the distribution of temperature-sensitive marine species (Hayward and Ryland 1995). The boundary selected, ie a line running from Portland to Cherbourg, was recognised by Holme (1966), who divided the English Channel on the basis of differences in tidal streams and water temperature stratification either side of this boundary, and is the same as that used by Dinter (2001) in relation to the OSPAR maritime area.

The offshore extent of Marine Natural Areas is the 200 nautical mile limit or the median line of UK Controlled Waters[3].

Inshore, we have used the Mean Low Water Mark as the boundary of the Marine Natural Areas. This means that the Marine Natural Areas overlap with the previously identified

[3] There are clear differences in the legal and institutional frameworks within 12 nautical miles (Territorial Waters) and beyond (UK waters). For example, beyond 12 nautical miles, the remit for providing advice on nature conservation changes from English Nature to the JNCC. However, wildlife and human activities cross such artificial administrative boundaries and therefore there is a need to work closely together to address issues of common concern. For the same reason, we feel it would be inappropriate to limit MNAs to the 12-mile administrative boundary. For convenience, the term "seas adjacent to England" is used when referring to waters within and beyond 12 nautical miles.

coastal Natural Areas (which extend from about 6 nautical miles to above Mean Low Water). These were based on the coastal process cells and sub-cells in which sediment movement is largely contained within discrete zones. However, the Marine Natural Areas span much greater areas as they reflect other, broader scale processes and the need to take account of large areas for pelagic species.

Estuaries and inlets are generally excluded from Marine Natural Areas as they are already covered within coastal Natural Area descriptions. However, in discussing and implementing an ecosystem approach to the maritime environment, it will be essential to take account of Coastal and Marine Natural Areas together.

1.3 The audience for this document

We hope that the Marine Natural Areas and the information presented in this document will be of use to those interested or involved in the stewardship of our seas. We envisage this will include those responsible for planning, regulating or managing human activities. This document is therefore aimed at a wide audience that includes local authorities, regional Government, and the Regional Development Agencies. We hope that the Marine Natural Area will also be of interest to a wider public as well as to national Government, other agencies, marine authorities, industry and the scientific community.

1.4 The aim and structure of this document

The main product from our work on Marine Natural Areas is a series of 'profiles', documents which provide a thumbnail sketch of each Area including its physico-chemical characteristics, key habitats and species, and, in brief, relevant human activities.

These documents are not intended to be a comprehensive description of all the wildlife and human interest within each area. Rather, they aim to highlight and describe key features of each Marine Natural Area from a nature conservation perspective. The main text begins with a description of the geology, physical processes and chemical conditions of each Natural Area. This provides the 'big picture' within which to consider nature conservation and human values of the area. The next two sections briefly describe the nature conservation value of the area in terms of habitats and then species. The final descriptive section outlines significant human activities.

Whilst we are publishing paper copies of the documents, the profiles will also be provided on CD and via the Internet (www.english-nature.org.uk). This is largely to facilitate use of the text by others, eg those progressing a regional approach to managing the marine environment.

Whilst the document contains some technical information it does not attempt to go into any great level of detail on any particular topic. Therefore the reader may wish to follow up on a particular topic by referring to other technical reports such as the JNCC's *Coastal Directories,* the *Marine Nature Conservation Review* (eg Hiscock 1996), the *Joint Cetaceans Atlas* (Reid *et al* 2003), and Regulation 33 advice published by the Agencies for European marine sites designated under the Habitats and Birds Directives. Further sources of relevant information and links to websites can be found at www.english-nature.org.uk and www.jncc.gov.uk. This document also provides references to material from other organisations.

A glossary of terms used throughout this report can be found in Appendix 4.

1.5 Geographic Information System

In addition to producing the profiles, English Nature has used a Geographic Information System (GIS) to hold and display the data referred to in this document. A number of other organisations have provided the data including the British Geological Survey (BGS), Centre for Environment, Fisheries and Aquaculture Science (CEFAS), the Crown Estate and Department for Environment, Food and Rural Affairs (Defra). GIS is invaluable for viewing data on different subjects altogether, often enabling a better understanding of the interaction between them. The Marine Natural Areas GIS is no exception and allows more detailed and dynamic use of data than can be shown in document form. We hope that the data will be useful in the further development of Marine Natural Areas and the implementation of any regional seas approach. We also hope to make the data available more widely but this will require agreement with those organisations that have provided data. Such access may be facilitated by initiatives to improve data sharing and integration in response to recommendations in *Safeguarding our Seas* (Defra 2002a).

1.6 Conservation objectives

We hope that the information set out in these profiles will contribute to a more comprehensive regional seas approach. We also intend to develop nature conservation objectives relevant to each Natural Area. However, we will do this within the current debate and emerging ideas about conservation objectives for broad sea areas, particularly through the work of the Irish Sea Pilot (see Lumb *et al* 2004 for example). This work will depend on the extent to which Marine Natural Areas become part of a more comprehensive regional approach to managing the seas around the UK.

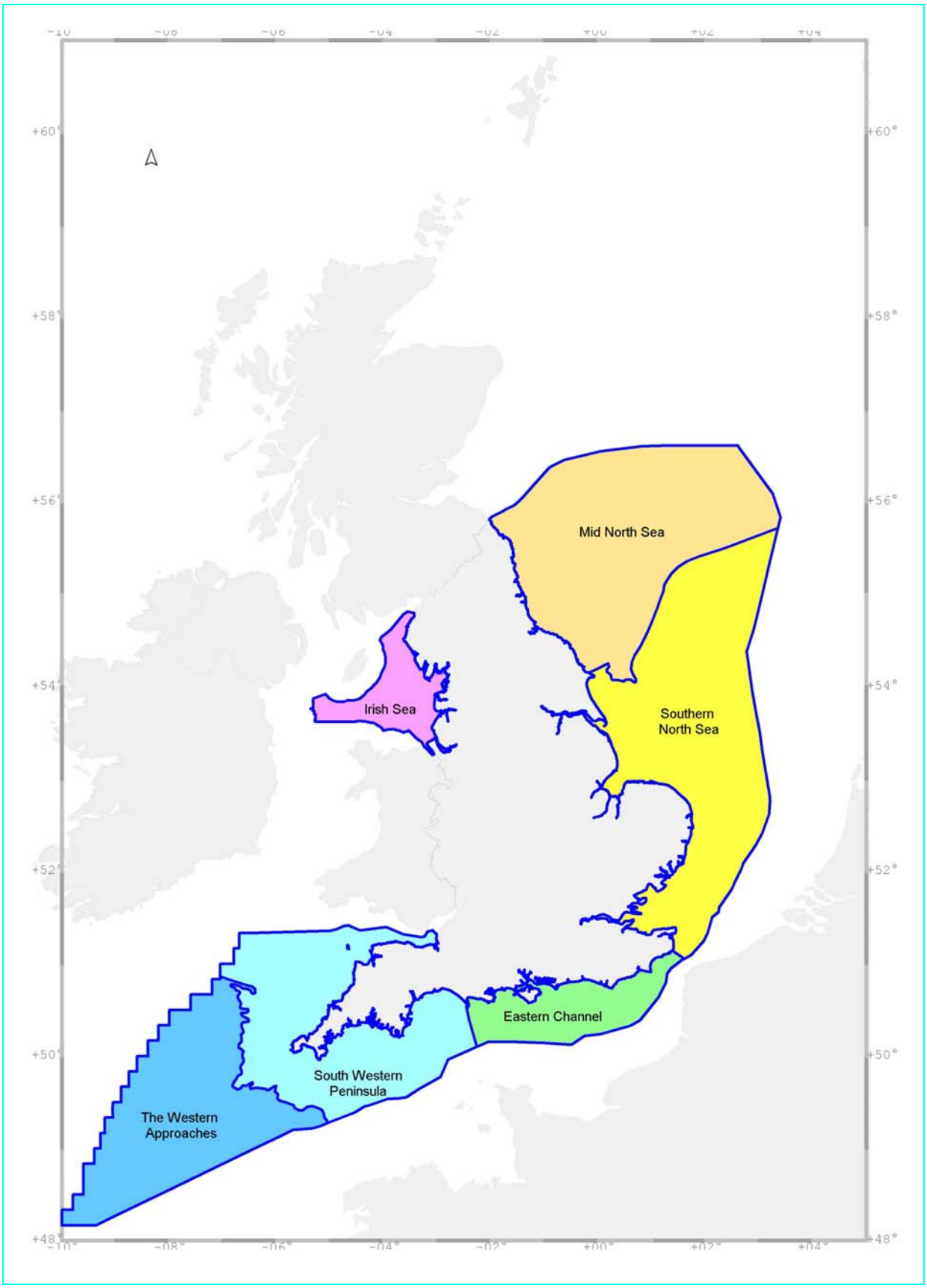


Figure 1.1 The six Marine Natural Areas around England.

2 General summary

The Mid North Sea Marine Natural Area extends northwards from the 50 metre isobath at Flamborough Head to the seaward extension of the England/Scotland border (Figure 2.1)[4]. The southern boundary follows a well known offshore frontal system (the Flamborough Front), where there is a distinct temperature gradient between the waters to the north and south of Flamborough Head. The inshore boundary is Mean Low Water (MLW) and the offshore boundary is the limit of UK jurisdiction. The area above MLW is within English Nature's coastal series of Natural Areas, whose boundaries are set out in Figure 2.1.

The seabed of the Natural Area slopes away uniformly from the coast to a depth of about 60 metres, the exception being the Farne Deeps trench which is over 100 metres deep. Sand, together with a mixture of sandy gravel and gravel, covers much of the offshore seabed. However, closer to the coast there are outcrops of bedrock along the Northumberland Coast and around the Farne Islands.

This Natural Area occurs within the Boreal biogeographic region (Dinter 2001). Its wildlife is influenced by water flowing into the North Sea off the east coast of Scotland. This cool current brings with it the larvae of species which occur along the west coast of Scotland and the island groups of Orkney and Shetland to the north. The contrast in sea surface temperatures from winter to summer contributes to the diverse and unusual range of species present within the Natural Area. The distributions of a number of species (such as the Devonshire cup coral) reach their northernmost limit on the east coast here.

Many important species occur within the Natural Area. These include a number of species covered by the UK Biodiversity Action Plans (BAP), eg cod and plaice which are included in a 'grouped' action plan for commercial fish. There is also a grouped action plan for baleen whales and small dolphins, and a separate plan for harbour porpoise.

The North Sea is one of the world's most important fishing grounds (OSPAR Commission 2000), and fishing remains one of the main commercial activities within this Natural Area (despite the restrictions imposed in recent years, such as decommissioning of vessels). The main species targeted by fisheries are cod, haddock, whiting, plaice, lemon sole and monkfish (Robson 1995). There is also a major crustacean fishery (for lobster, crabs and *Nephrops* [scampi] in particular) and a molluscan shellfish fishery (for queen scallops, scallops, cockles and whelks). In addition, there is some oil production in the north east of the Natural Area as well as a number of undeveloped gas reserves in the south western sector of the Area.

[4] The northern boundary of this Natural Area is the Scottish border, as the Marine Natural Area concept has not been developed for Scotland. Additionally, some of the legislation described in later chapters is not applicable in Scotland. We envisage that as the concept of regional seas develops, these somewhat arbitrary boundaries may be revised.

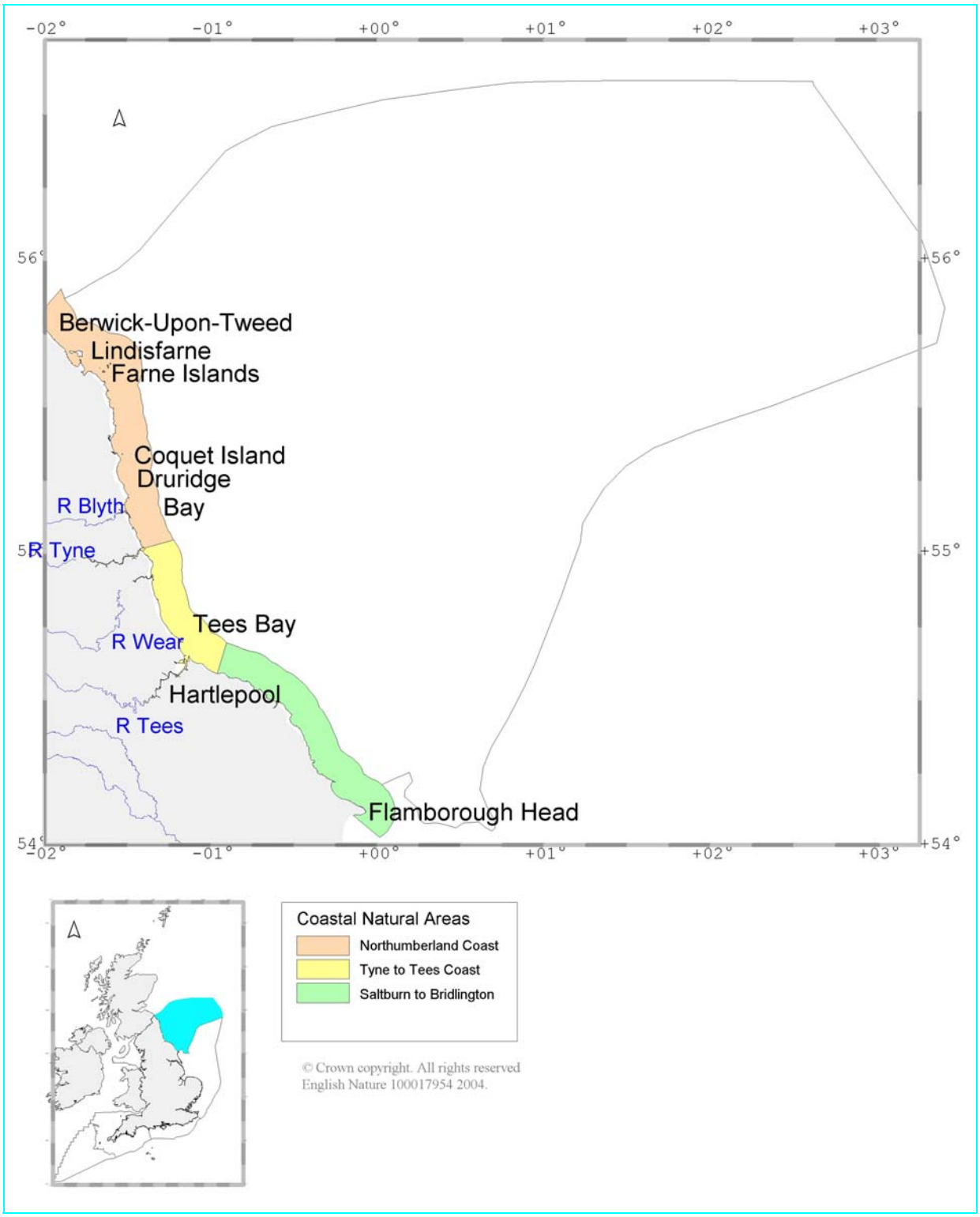


Figure 2.1 Mid North Sea Marine Natural Area and adjacent coastal Natural Areas with the names of places mentioned in the text.

3 Physical environment and character of the Natural Area

This section outlines the geology, physical processes and chemical characteristics of the Natural Area. It describes the underlying processes that determine the presence of natural features and biodiversity, and which in turn influence human activities. For simplicity, the human influences on physical and chemical characteristics, such as water quality, are described in the same section.

3.1 Geology

The geology of the Natural Area has direct and indirect influences on the morphology of the seafloor, the distribution of seafloor sediments, and the distribution of many of the associated habitats. Many of these influences form a complex set of inter-relationships. The broader geological patterns (such as range of rock types and geological structures) were set in the early geological history of the area. But, more recent geological events (in particular the sea level changes associated with glaciation, as well as the glaciers themselves) have had a profound effect upon the distribution of modern seafloor topography and sediments. Given the complexity of the geology, the description given below is necessarily brief.

The bedrock underlying the Mid North Sea Natural Area ranges in age from Carboniferous (363 to 290 million years ago) to Pleistocene (1.6 million years to 10 thousand years ago). Generally, the oldest rocks are at the seafloor near the coast in the north. Younger, Palaeogene and Neogene rocks occur across much of the eastern part of the area, thickening progressively toward the central North Sea. Permian to Triassic rocks outcrop in other parts of the area.

In terms of its geological structure, the major feature of this part of the North Sea is the Central Graben to the east, on the margin of the Natural Area. It consists of an array of faults associated with the stretching and thinning of the crust in an east-west direction, running along a north-south axis. The associated subsidence (which continues today) provided the space for the large volume of Jurassic to Pleistocene age rocks deposited in the eastern part of the Natural Area. Other faults with predominantly east west or north west – south east trends are responsible for the development of subsidiary structures such as the Cleveland Basin. At times these structures have been the focus for the accumulation of thick layers of sediment. At other times, they have been uplifted and acted as sources of sediments. Many of these structures have been responsible for trapping hydrocarbons, whilst some of the sediments, in particular those of the Jurassic, were hydrocarbon sources.

The nature of the bedrock is diverse and ranges from clays and mudstones to sandstones and limestones. Salt deposits also occur. Outcrops of basic igneous rocks, in the form of the Whin Sill, extend from the Northumberland Coast to the Farne Islands. The rocks provide evidence for a complex history and the Natural Area has at various times been a tropical sea, a tropical forest, an enclosed evaporating sea, a desert and a river delta.

Despite the diversity of the rocks forming the bedrock of the Natural Area, these rocks do not appear on the seafloor except in some inshore areas (Figure 3.1). Where these rocks do outcrop on the seafloor, they have provided substrata for the development of sea caves and extensive reef habitats. These are particularly well developed in the Carboniferous

limestones and sandstones of the Northumberland Coast, as well as the basalt of the Whin Sill. Further south, off Cleveland and North Yorkshire, Lower Jurassic shales form a softer, but still extensive substrata.

However, most of the seafloor of the Natural Area consists of sands and gravels that are Pleistocene or younger in age. The oldest of these consist of marine and estuarine sediments from rivers that once extended further north into the North Sea. Resting upon these are marine, estuarine and glacial sediments that underlie much of the modern floor of the North Sea. The sediments reworked from these deposits form much of the substrata.

While the pattern of the reworked sediments is a key factor controlling the distribution of benthic habitats, the underlying geology also influences their distribution. For example, there are extensive areas of muddy sand and sandy mud off the Northumberland Coast (see Figure 3.1). These originated from the glacial erosion of a trough along the outcrop of relatively soft Permian rocks, that was later filled with mud as the ice retreated. The Dogger Bank is formed of glacial outwash deposits as opposed to the boulder clays that floor much of this part of the North Sea. These well-bedded deposits have resisted erosion, so the bank forms a raised feature that influences the convergence and mixing of Atlantic water and residual flows from the English Channel.

3.2 Bathymetry

The Mid North Sea is relatively deep in the north (offshore depths in general exceeding 100 metres), whereas the southern part of the Natural Area is relatively shallow (offshore depths in general being less than 50 metres - see Figure 3.3). These depth differences affect the characteristics of the water masses within the North Sea (see also sections 3.3, 3.5 and 3.6).

Closer inshore, the seabed slopes to a depth of 40 metres south of the Tees and to 60 metres north of the Tees. Seaward of the 60 metre contour, the seabed flattens out and for the most part forms a gently undulating surface. South east of the Farne Islands, some 15-30 kilometres offshore, there is a conspicuous depression, the Farne Deeps, where the seabed is over 100 metres deep in places.

3.3 Tidal currents and range

The tidal currents in the Mid North Sea flood southwards and ebb northwards. North of the Farne Islands, the nearshore maximum tidal current speed during mean spring tides is 0.5 metres per second (approximately equivalent to 1 knot), increasing to about 0.7 metres per second in Tees Bay. The tidal current flow offshore runs more or less north to south, but closer to the shore the flow is affected by the form of the coast. For example, tidal currents are stronger around headlands such as Flamborough Head (up to 1.5 metres per second), and eddies or gyres may form within embayments such as Druridge Bay and Hartlepool Bay.

The tidal ranges within this Natural Area are smaller than along some other parts of the North Sea coast (eg the Firth of Forth or the Humber and Thames estuaries), but larger than those elsewhere in the North Sea. For a variety of reasons (see Pugh 1987) there are higher high tides and lower low tides than might otherwise be expected.

Thus the mean spring tidal range increases from just over 4 metres off the Farne Islands to over 4.5 metres off the mouth of the Tees (Crosby 1995a).

3.4 Sea-level change

3.4.1 The past and present

Changes in sea level derive from the combined effect of two phenomena. The first are 'local crustal movements' where Scotland is rising and southern England sinking, due to the removal of the weight of ice since the last glacial period. This is also known as isostatic or post-glacial adjustment. The second is a global rise in sea level, which has been estimated as rising at between 1.5 and 2 millimetres per year (IPCC 2001). This is known as eustatic or sea-level change.

Geological evidence for sea-level change in the past may be found in the presence of fossil coastlines (raised beaches, etc) on or inland from the present shorelines, or in the presence of peat and alluvial gravels on or below the sea floor. Multiple or individual raised beaches, ie former beaches which are now higher than the contemporary shoreline or platforms, may produce a stepped or staircase profile to the coast. These features are higher than their modern equivalents, implying a higher sea level during their formation. There is also evidence for shoreline change in deposits below present sea level and this indicates where coasts have been submerged since the sediments were laid down.

The whole of the North Sea coastal margin contains widespread evidence of sea-level changes, reflecting the combined effects of both isostatic and eustatic controls. The most detailed information is available for changes during and since the retreat of the last ice sheet (about 18,000-10,000 years before present). Isostatic change within the Natural Area is small. The line of 'zero change' suggested by Shennan (1989) runs through the Tees estuary, with Lindisfarne experiencing a rise of 0.5 millimetres per year and Flamborough a fall of 0.5 millimetres per year. Tide gauge data (as examined by Woodworth *et al* 1999) confirmed that the mean sea level throughout the Natural Area is rising at between 0 and 2 millimetres per year.

3.4.2 The future

As with all predictions of climate and sea level change, the following figures carry a range of uncertainty with them. Global mean sea level increased by 1.0-1.5 millimetres per year during the 20th century. The Intergovernmental Panel on Climate Change have predicted that mean sea level would rise by 48 centimetres by 2100 and the range will vary by 9-80 centimetres, as a result of the thermal expansion of ocean water and melting ice from the poles. Although the coastline of north east England is not generally at risk from flooding, several stretches could be affected by a combination of sea level rise and increased storminess. Most noticeably, these will include low-lying areas adjacent to Lindisfarne, the Blyth estuary and the Tees estuary (Crosby 1995b).

The gradual rise in sea level will have serious implications for important coastal wildlife habitats, though it is difficult to say exactly what may happen as the rate will be tempered by the rise in land level too. Habitats particularly vulnerable to 'coastal squeeze' (where they are trapped between an advancing sea and 'fixed' land defences) include shingle beaches,

saltmarshes, grazing marshes and estuaries. A good source of further information is on the Proudman Oceanographic Laboratory website (**www.pol.ac.uk/ntslf/reports**).

3.5 Water temperature

In winter, the waters of this Natural Area are some of the coldest in the UK. In February (the coldest month), the mean surface water temperature varies from 5.5 ºC to 6 ºC throughout the Natural Area. At this time of year when winter storms lead to thorough mixing of the water column, sea bottom temperatures do not vary greatly from those at the surface. In late spring, solar energy heats up the surface layer and a distinct vertical temperature gradient (or thermocline) is produced, which acts as a thermal barrier between the upper and lower layers. In August (typically the warmest month for sea temperatures), the mean surface water temperature within this Natural Area increases from 13 ºC close to the coast in the north to 14.5 ºC approximately 50 kilometres offshore. Surface waters close to the coast in the southern part of the Natural Area also reach a high of approximately 14.5 ºC. Freshwater inputs from the rivers Tyne, Wear and Tees can have a local affect on nearshore surface water temperatures.

3.5.1 Predicted rises in seawater temperatures

According to UK Climate Impact Programme predictions (**www.ukcip.org.uk**), a gradual rise in seawater temperature in the coastal waters surrounding Britain and Ireland may already be occurring, and by 2100 average temperatures may be 2 °C higher compared to 2000. Air temperatures are also rising. Hiscock *et al* (in prep.) report that it is most likely that seawater temperatures in inshore waters around Britain and Ireland will increase progressively over the next 50-100 years, according to the most recent predictions and historical precedents. By the 2050s, surface seawater temperatures may be as much as 2.5 °C higher in summer and 2.3 °C higher in winter than in 2000 (Viles 2001). It may be that, in enclosed waters especially, the rise of inshore seawater temperature may be higher than the average on the open coast.

Hiscock *et al* (in prep.) predict the effects that seawater temperature rises may have on marine wildlife. Increasing temperature may induce changes in the abundance and distribution of species, but there will not be a wholesale movement northwards of southern species, or a retreat northwards of northern species. Factors such as the hydrodynamic characteristics of water masses, the reproductive mode of species, the presence of geographical barriers and the longevity of already established species will be important in determining whether or not there is a significant change in species distribution and abundance in the next hundred years.

3.6 Salinity

The salinity of seawater within this Natural Area is relatively uniform, ranging from 34.50 to 34.75 in summer and 34.25 to 34.50 in winter (Lee & Ramster 1981). Salinities decrease slightly close to the coast and in the vicinity of river mouths (such as the Tyne, Wear and Tees), where there is dilution by freshwater inputs.

3.7 Water quality

About 80% of marine pollution comes from a variety of land-based activities (Defra 2002a). Most pollutants enter the Mid North Sea through direct discharges of effluents or land run-off (mainly via rivers). The highest concentrations of contaminants, and hence the greatest effects, are therefore often in inshore areas. Additional inputs include sources at sea (ships, offshore platforms, disposal of dredged materials) and atmospheric deposition. On entering the sea, the fate and behaviour of chemicals will vary markedly depending on their physio-chemical properties, and the physical characteristics of the receiving environment.

The following section provides a summary of the water quality in the Natural Area, including consideration of sediment and biota quality.

3.7.1 Turbidity

Turbidity is a measure of the decrease of light down through the water column and is primarily due to Suspended Particulate Matter (SPM), including plankton; plankton is dealt with in greater detail in section 4.1.1. Turbidity can affect water quality in a number of ways especially in relation to oxygen levels, algal growth, nutrient cycling and the availability of particle reactive contaminants.

Within this Natural Area, the regions with the greatest concentration of SPM (up to 5 milligrams per litre) occur nearer the coast particularly in the vicinity of estuaries such as the Tyne, the Wear and the Tees (OSPAR Commission 2000). Areas with lower concentrations of SPM (<0.1 milligrams per litre) tend to occur further offshore. Based on studies undertaken for the UK National Monitoring Programme, CEFAS (1998) reported that the North Sea has two distinct areas according to distributions of SPM. Waters monitored within the northern North Sea (including this Natural Area) were much less turbid than stations in the southern North Sea, as they are largely influenced from low turbidity waters inflowing from the North Atlantic.

3.7.2 Non-toxic contaminants

3.7.2.1 Organic matter

Organic matter can enter the Mid North Sea through externally or internally derived sources. External inputs of organic matter include point source discharges of sewage and industrial effluents, and from diffuse sources such as agricultural run-off. Organic matter can enter the marine environment in both dissolved and particulate form. However, in common with most land-based sources of pollution, the effects from these inputs are more noticeable in estuaries and nearshore areas and are unlikely to be detected in offshore locations within this Natural Area. Inputs of organic matter exert an increased biochemical oxygen demand (BOD) in receiving waters, which can lead to oxygen depletion in water and sediments. Reductions in point sources of organic matter are being addressed through implementation of the Urban Waste Water Treatment Directive (91/271/EEC).

3.7.2.2 Nutrients

Nutrients (dissolved and particulate forms of nitrogen, phosphorus and silicon) play an important role in aquatic ecosystems as they are the basis for primary productivity. Nitrogen and phosphorus enter the Mid North Sea predominantly from point sources, such as sewage

treatment works and from diffuse sources, such as agricultural run-off. Rivers often transport nutrients from both sources. In nutrient-poor waters, atmospheric deposition of nitrogen can be a significant source of this nutrient. Silicon, essential for the growth of diatoms but of less importance for other marine organisms, enters the North Sea predominantly via rivers.

The ratio of nitrogen/phosphorus consumption for marine phytoplankton is 16:1, and under normal circumstances, nitrogen is the limiting nutrient in marine waters (North Sea Task Force 1993). Nutrient enrichment could have little or no impact on aquatic environments, depending on the influence of a number of physical, chemical and biotic factors (Scott *et al* 1999). In some cases, enrichment of marine waters with nutrients may stimulate accelerated growth of algae or other higher plant forms, and result in adverse ecological impacts. This process is known as eutrophication. Observable signs of eutrophication in the marine environment include repeated phytoplankton blooms, increased fluctuation in dissolved oxygen concentrations, increased turbidity, and increased occurrences of toxic blooms. These effects are more likely to be observed in estuaries and nearshore areas.

Improvements to sewage treatment under the Urban Waste Water Treatment Directive are likely to reduce some point sources of nitrates. The implementation of the Nitrates Directive (91/676/EC) will also provide some controls on nitrate from diffuse agricultural sources. This Directive requires Member States to designate Nitrate Vulnerable Zones (NVZs) and to produce action programmes to reduce nitrate run-off from agricultural areas. Those areas already identified are shown in Figure 3.4. In the first instance, these measures are established to ensure that nitrate levels in rivers and groundwater are below 50 milligrams per litre (drinking water standard).

3.7.3 Toxic substances

3.7.3.1 Oil

The input of any petroleum hydrocarbons within this Natural Area will most likely be the result of sea-based activities (shipping and oil/gas extraction) or coastal discharges of sewage and industrial effluents. Oil spills may occur from both ships and offshore installations, and can be the result of both legal and illegal discharges or accidents. The majority of these spills consist of ship's 'bilge oil' and, increasingly, heavy fuel oil, but crude oil and lubricating oils also occur along with non-mineral oils (OSPAR Commission 2000).

Drill cuttings, produced during exploration drilling, can result in oil being released into the marine environment by the use of diesel-based drilling fluids, but this substance has been banned. Now, alternative oil-based drilling fluids can only be used if the level of oil in the cutting is less than 1%. Waste is shipped ashore for disposal or re-injected, which has the effect of reducing discharges to the marine environment. There may also be some contaminated water discharges from the oil-producing installations in the north eastern part of the Natural Area.

3.7.3.2 Trace metals

Trace metals reach the Mid North Sea predominantly via rivers, direct discharges, and from some sea-based activities, such as exploitation of offshore resources and disposal of dredged materials. Highest concentrations of trace metals are found near freshwater outlets, with much lower levels in the open sea.

Factors controlling the distribution of trace metals in this Natural Area are likely to include water circulation patterns and levels of suspended particulate matter (SPM). CEFAS (1998) reported that trace metals in general (with the exception of lead) are lower in the northern North Sea (corresponding with this Natural Area) than in the southern North Sea. This is due to the river inputs from eastern Britain being carried south. CEFAS noted that lead concentrations are more influenced by SPM levels due to its particle reactivity, and high levels of SPM can remove lead from the water column. Therefore in turbid estuaries, lead can be removed and not transported by circulatory patterns. In the North Sea overall, the mean concentrations of cadmium and lead have decreased compared with 1982-1985 and 1986-1990 levels (OSPAR Commission 2000). This reflects a significant reduction in the input of heavy metals from trade and domestic effluents. The North Sea overall has higher concentrations than the English Channel, as a result of land-based inputs (CEFAS 1998).

Like lead, some metals show a strong affinity for particulates and can accumulate in sediments that may subsequently accumulate up the food chain. Monitoring for the National Monitoring Programme between 1992 and 1995 found higher concentrations of metals in sediments at estuarine sites than at offshore sites, with relatively high concentrations for a number of metals in the Tees and Tyne estuaries (Marine Pollution Monitoring Management Group 1998).

Elevated levels of both mercury (0.5 mg/kg dry weight) and zinc (200 mg/kg) have been found in common mussels *Mytilus edulis* in the Tees estuary. Relatively high levels of arsenic (20.4 mg/kg wet weight) were recorded in muscle tissue from dab *Limanda limanda* caught off the Tees estuary, and also of lead (0.41 mg/kg) in dab liver from the same location (CEFAS 1998).

3.7.3.3 Trace organics

It has been estimated that there are probably more than 60,000 organic pollutants present in the marine environment (Maugh 1978). The following section provides information on some of the more commonly studied groups of chemicals.

Organo-tin compounds

Tributyl tin (TBT) is widely used as an anti-fouling agent in paint for ships. Its use has been banned for vessels under 25 metres in length since 1987, since it was shown to be having a harmful effect on molluscs such as dogwhelks and oysters. But, TBT is still commonly used in ships longer than 25 metres. These vessels still act as a major input source to the marine environment. TBT concentrations in offshore waters are generally less than 1 µg/l when compared with values recorded up to 100 µg/l in frequently used waterways. The current Environmental Quality Standard for tributyl tin in seawater is 2 µg/l (Cole *et al* 1999). CEFAS (2001a) could not detect TBT in water collected at stations within this Natural Area. Thomas *et al* (2000) could not detect TBT in sediments off Tees Mouth (<0.002 µg/g), and concluded that there would be little accumulation of TBT in offshore sediments. However, TBT has been detected in the tissue of pelagic cetaceans. For example CEFAS (2001a) reported a concentration of 36 µg/kg in the liver of a white-beaked dolphin found in Blyth, Northumberland in 1998.

The International Maritime Organisation adopted a Convention on the Control of Harmful Anti-fouling Systems at a Conference in October 2001. Amongst other measures, this (a) prohibits the application or re-application to ships of organo-tin (TBT) compounds as biocides in antifouling systems from 1 January 2003; and (b) requires that vessels already painted with organo-tin compounds acting as biocides either remove the paint or cover it with an impermeable barrier by 1 January 2008[5].

Polychlorinated biphenyls (PCBs)

Historically, the majority of PCBs entering coastal waters have been from river inputs, whereas atmospheric deposition was a more important input to the open sea. The main source has been the disposal of electrical equipment (OSPAR Commission 1998). It is estimated that more than 90% of the total release of PCBs occurred before 1980, though low levels of release do still occur. Due to the hydrophobicity (water repellence) of these compounds, concentrations in surface waters are extremely low, and in most cases undetectable (MPMMG 1998). PCBs are persistent, will bind to sediments and can be accumulated up the food chain.

Concentrations in sediment and biota are markedly higher in nearshore areas than the open sea. For example, CEFAS (1998) found concentrations of PCBs in sediment offshore adjacent to the Tees and Tyne estuaries as between 2.81 and 4.63 µg/kg. According to concentration guidelines defined by Wells *et al* (1989), these sediments fall into the "slightly contaminated" category. These concentrations are lower than that found in dredged sediment taken from UK estuaries, which typically contain 10 of µg/kg (CEFAS 2001a). CEFAS (1998) reported PCBs in dab liver of between 0.028 to 0.059 mg/kg collected from offshore stations adjacent to the Tees and Tyne estuaries.

Polycyclic aromatic hydrocarbons (PAHs)

PAHs are formed during the incomplete combustion of fossil fuel, and are also components of petroleum products. They will enter the Mid North Sea via industrial and sewage discharges, surface run-off, atmospheric deposition and oil spills. MPMMG (1998) found highest concentrations of PAHs in the water column were in estuaries, including the Tyne and Wear (with total PAH concentrations > 1 µg/l). At sites further offshore from the Tyne, PAHs were undetectable. Like PCBs, most PAHs show a strong affinity for particulates, will accumulate in sediments and may bioaccumulate up the food chain. CEFAS (1998) reported concentrations in sediments collected offshore from the Tees estuary contained PAH of up to 1495 µg/kg compared with concentrations over 40,000 µg/kg found in sediments taken from the Tyne estuary.

3.7.3.4 Endocrine disrupters

Some contaminants can act as endocrine disrupters, as they have the ability to adversely change endocrine function in fish and other animals. Known, or potential, endocrine disrupters include natural and synthetic hormones, and industrial chemicals. The Quality

[5] The provisions of the Convention are being implemented in Europe by two instruments:

- Directive 2002/62/EC, which amends Directive 76/769/EEC and prohibits the placing on the market of organotin compounds as biocides to prevent the fouling of all craft used in marine, coastal, estuarine and inland waterways and lakes.
- Council Regulation (EC) 782/2003 addressing vessels already treated with organotin compounds as biocides.

Status Report on the North Sea (OSPAR Commission 2000) highlighted that more research was needed into the effects of endocrine disruption in marine species. Allen *et al* (2000) reported that reliable information on the effects of endocrine disruptors in aquatic wildlife is patchy, with the most complete data available for fish exposed to oestrogens and their mimics. Relatively poor information is available on other marine vertebrates such as birds and mammals. Knowledge of endocrine disruption in invertebrates is even sparser because their endocrine systems are poorly understood, although there is one example (the effects of TBT in molluscs) which is well documented.

Although the effects of endocrine disrupters tend to be greater in estuaries, less severe oestrogenic effects have been observed in offshore flounder *Platichthys flesus* in the Southern Bight of the North Sea (off Holland) (Allen *et al* 1997). The effects on the offshore spawning populations of flounder are likely to be due to exposure to oestrogenic compounds in estuaries. However, the possibility of contamination in the open sea cannot be excluded.

A recent report on *Endocrine Disruption in the Marine Environment* (Defra 2002b) details the findings of a £1.5 million 3-year project involving Defra, Government agencies and the chemical industry's Long-Range Research Initiative. The project found that endocrine disruption does occur in some species at certain estuarine locations, and a range of chemicals may be implicated. There is insufficient field data currently available to assess whether such changes impact on reproductive success.

3.7.3.5 Radionuclides

Radioactivity has both natural and man-made sources. Inputs to the sea from natural sources, which are often enhanced by human activity, originate mainly from mining and ore processing, oil and gas extraction, burning coal, oil or natural gas in thermal power plants and the production of phosphate fertiliser (OSPAR Commission 2000; European Commission 2002). Artificial radionuclides in the Mid North Sea originate from the nuclear fuel reprocessing plants at Sellafield (Cumbria) and Cap de la Hague (near Cherbourg, north west France). They also come locally from the nuclear power station at Hartlepool, as well as from fallout from the Chernobyl accident and atmospheric nuclear weapons testing in the 1950s and early 1960s. Data on radionuclide levels in the area are regularly published by the Food Standards Agency and Scottish Environment Protection Agency. These have decreased in recent years, reflecting the levels observed for the North Sea as a whole (OSPAR Commission 2000).

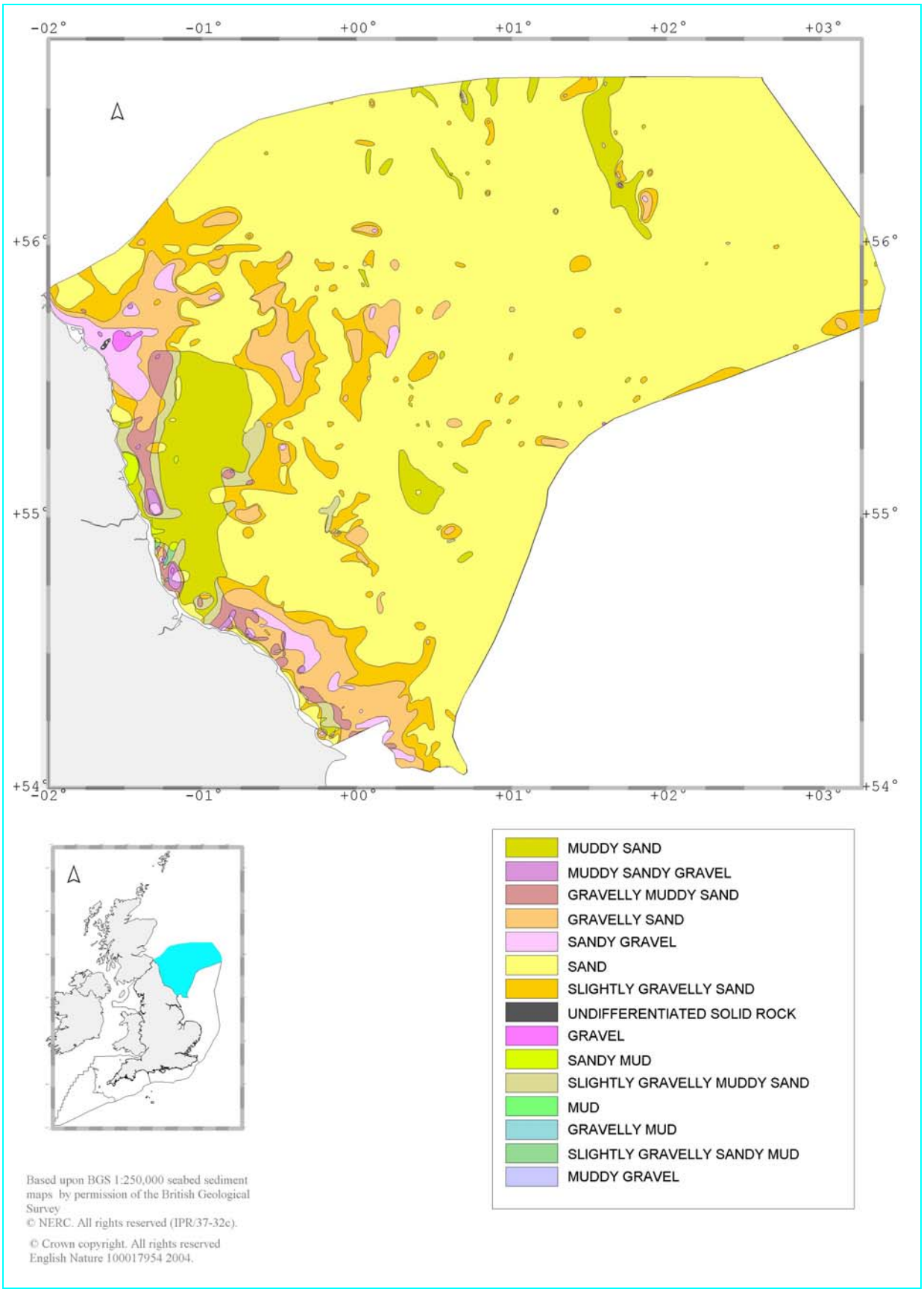


Figure 3.1 Seabed sediments of the Mid North Sea Natural Area. (taken from Poulton *et al* 2002) See Figure 3.2 for definitions of sediments.

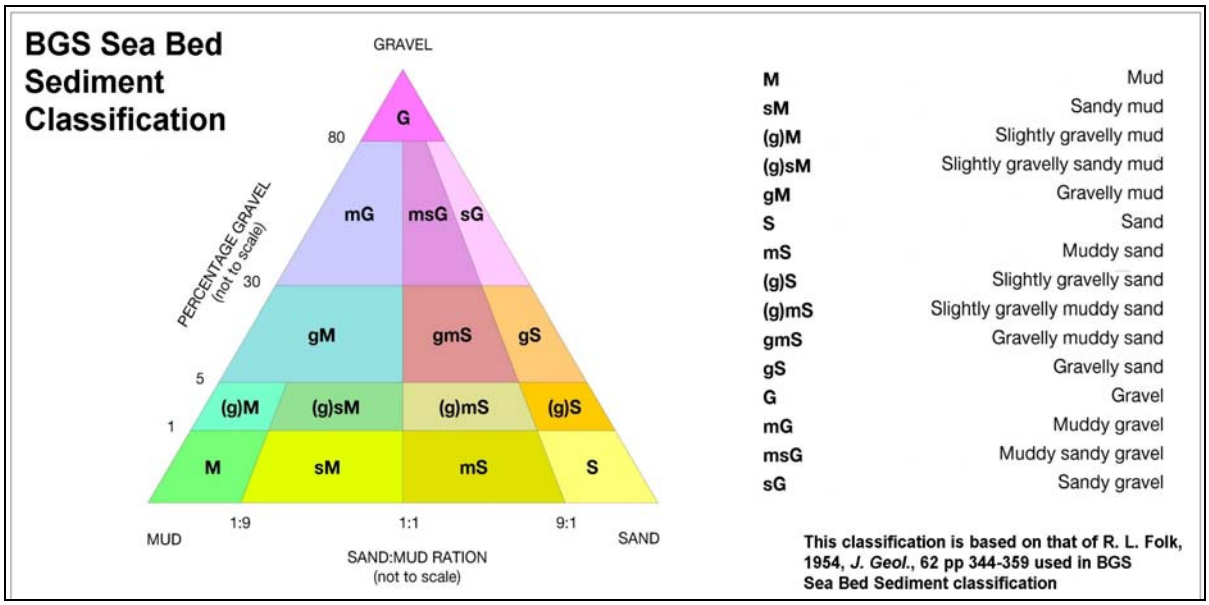


Figure 3.2 British Geological Survey sea bed sediment classification taken from Poulton *et al* (2002).

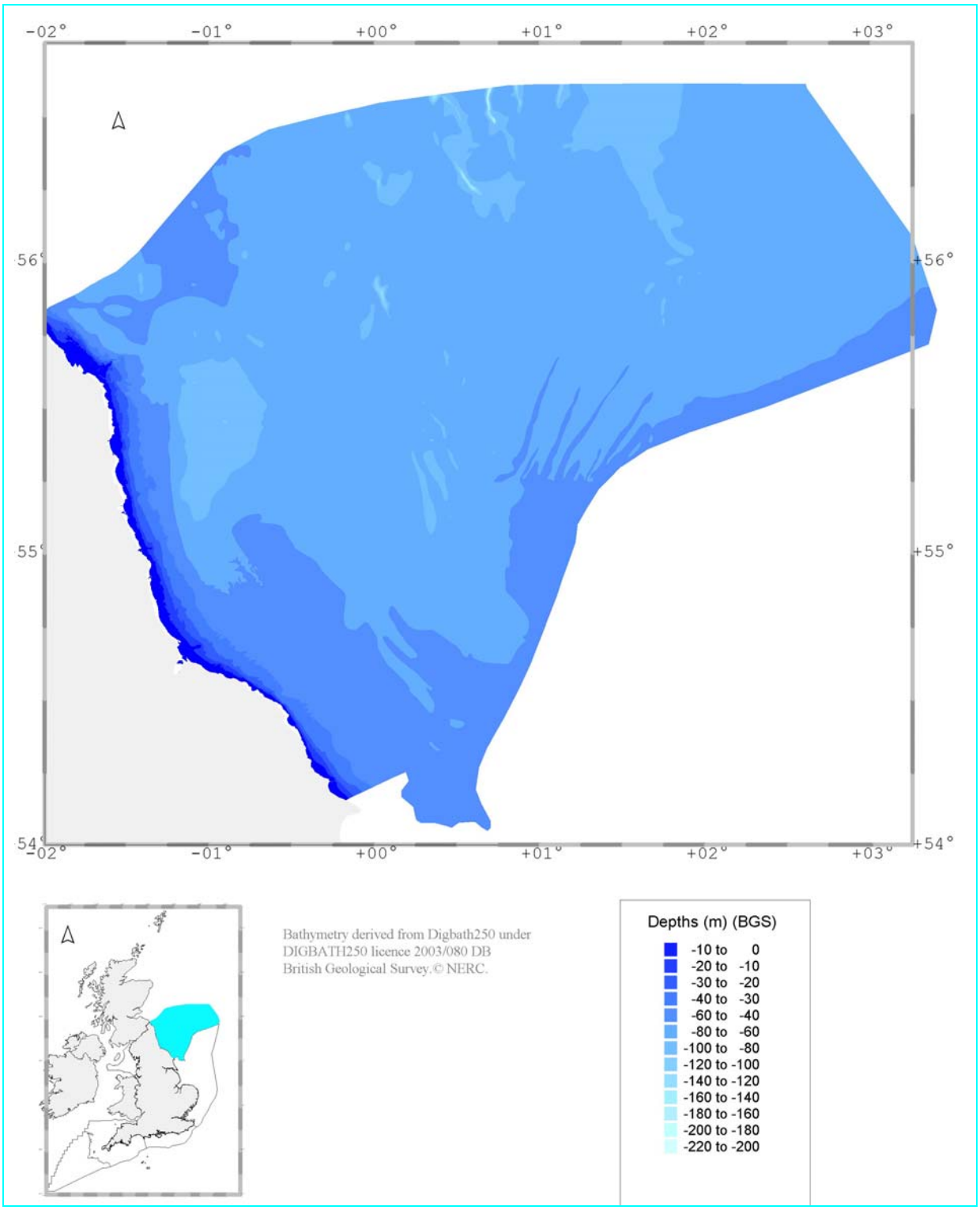


Figure 3.3 Bathymetry of the Mid North Sea Natural Area.

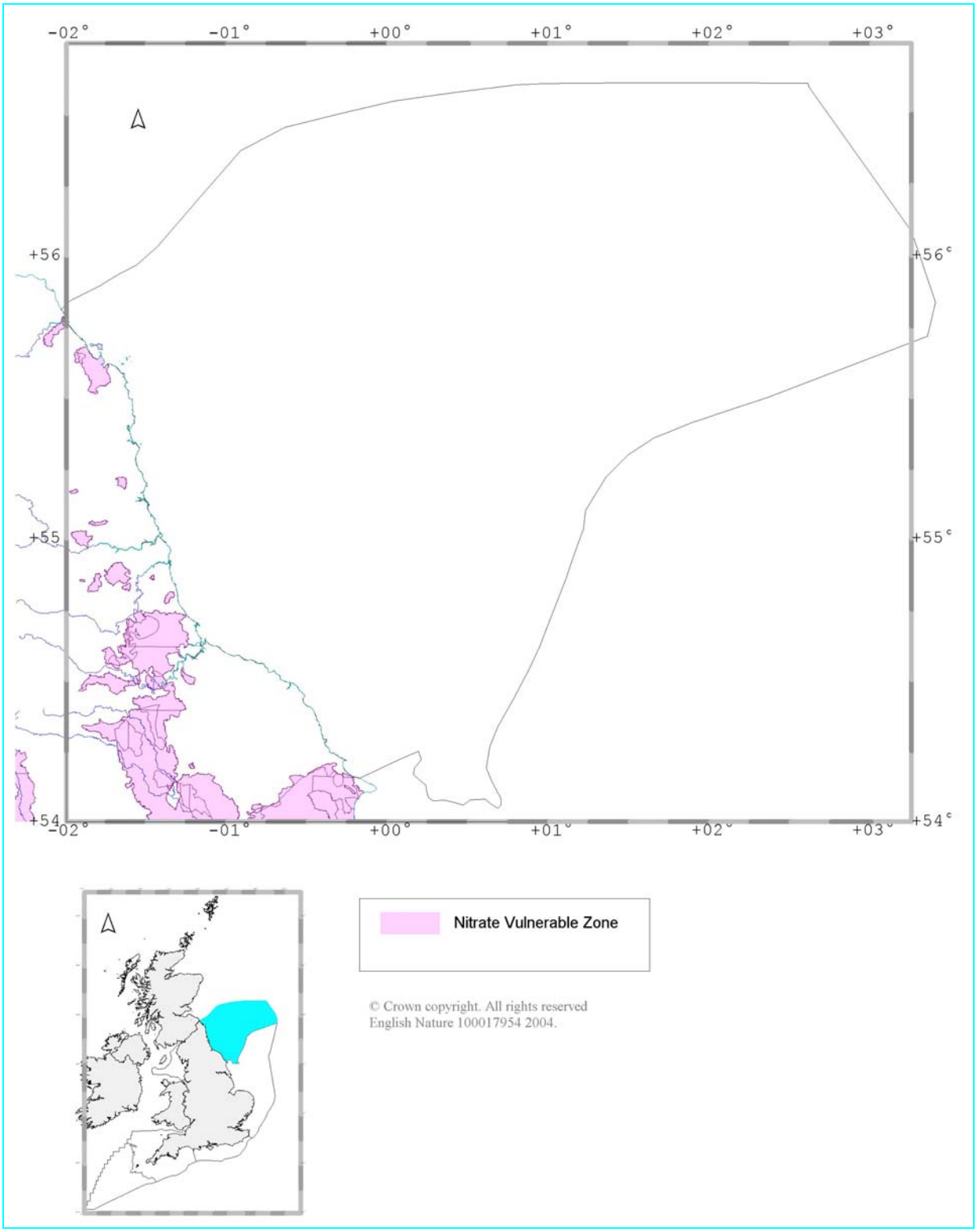


Figure 3.4 The distribution of Nitrate Vulnerable Zones (NVZ) adjacent to this Natural Area (map provided by Defra).

4 Key habitats

This section describes the main habitats in the Mid North Sea Marine Natural Area. Different initiatives have used different ways of classifying seabed habitats (particularly the Habitats Directive and the Biodiversity Action Plan systems identified in table 4.2 and Appendix 2). Here we have taken account of both. This section gives a description of the water column (to highlight its importance), the seabed geology and the different types of sediment and rock habitat present, largely based on information provided by the British Geological Survey. However, certain habitats that are formed by plants or animals are also described to highlight both their conservation and functional importance. For each feature, the main specific conservation measures currently in place are noted, to indicate the effort being made towards their protection.

The intention is to provide the 'big picture' with selected highlights rather than a detailed description of habitats which would repeat information provided elsewhere (such as designated site citations or environmental statements).

4.1 The water column

The waters of this Natural Area are largely influenced by the North-East Atlantic. Surface currents (moving at approximately 2½ kilometres per day, Lee and Ramster 1981), sweep relatively warm water northwards around the west coast of Scotland, through the Pentland Firth (between Orkney and the mainland), and then southwards along the east coast of Scotland. By the time it reaches this Natural Area, it has become mixed with North Sea water (the movement of which is variable and wind-driven) and south-flowing, colder water from Shetland.

Plankton (both phytoplankton and zooplankton) provides a fundamental role in the food chain of pelagic (oceanic) wildlife. Any stress imposed on the plankton will have consequences throughout the food chain and may affect the food available to fish, birds and marine mammals, etc (Edwards and John 1995). The abundance of plankton is strongly influenced by factors such as water depth, tidal mixing and temperature stratification, all of which determine the vertical stability of the water column. The distribution of planktonic species is influenced directly by salinity and temperature, by water flows in the area and by the presence of local seabed communities.

Plankton blooms begin well offshore in March, when nutrient levels are high, the amount of daylight increases and the seawater gradually warms. Within this Natural Area blooms are dominated by diatoms which spread westwards to cover the Natural Area by April. After the diatom peak, dinoflagellates *Ceratium lineatum* and *Dinophysis norvegica* become dominant during summer in nearshore areas (Edwards and John 1995). Diatoms tend to predominate in inshore mixed waters, while dinoflagellates are more often found in stratified offshore waters during the summer and autumn.

These waters support important commercial fisheries, with several species of fish feeding directly on plankton. In addition to these species, plankton has a fundamental role in the food chain of many species of benthic and pelagic wildlife, including jellyfish and non-exploited fish such as the basking shark.

Along the rocky sections of the coast in the north and the south of the Natural Area, the clear, unpolluted waters are of high nature conservation importance. However, off Tyne and Wear and along the County Durham and Cleveland coasts, pollution, particularly from dumped colliery waste, has long impoverished the marine environment (Doody 1995).

4.1.1 Fronts

Fronts mark the boundaries between water masses and are a common feature of the North Sea. They are transition zones between 'layered' and 'well mixed' waters, and give rise to a marked horizontal temperature gradient in the surface layers, with changes of 1 ºC per kilometre being common (Lee and Ramster 1981). The temperature change may be as much as 6 ºC over a vertical distance of as many metres. The strength of this thermocline depends on the heat input and the turbulence generated by tides and the wind. The depth of the thermocline also varies, ranging from 10 to 30 metres, typically getting progressively deeper from May to September as surface water temperatures increase.

One of the most distinct fronts in the North Sea, 'the Flamborough Front', forms the southern boundary to this Natural Area. This front occurs between the deeper waters to the north and the vertically mixed waters to the south of Flamborough Head which are permanently mixed. These frontal regions represent important physical, chemical and biological boundaries. Studies have shown that these boundaries are significant in determining distributions of phytoplankton (Pingree *et al* 1975). This is because the features of frontal systems largely influence the availability of light and nutrients to plankton. Within the frontal zone both primary and secondary production are enhanced, and this attracts fish, birds and cetaceans.

4.1.1.1 Nature conservation measures

There are no conservation measures that specifically protect fronts. However, fronts may be subject to some indirect conservation measures if they support concentrations of individuals from a species that qualifies for protection.

4.2 The seabed substrata

The benthic habitats of the Mid North Sea Natural Area are defined primarily by the seabed substrata. Within the Natural Area, the offshore seabed is composed predominantly of sand with some gravelly sand and muddy sand patches. Closer inshore, the sediment has a higher proportion of mud. This gives rise to extensive areas of muddy sand, gravelly muddy sand and muddy sandy gravel (Figure 3.1), particularly close to the mouth of the Tees and northwards towards the Farne Islands. The nearshore seabed is composed of an assortment of mixed sediments, with more muddy and sandy gravel and fewer areas of sand. Where gravelly sediments are consolidated and stable, an associated rich fauna more characteristic of rocky areas can develop. In the nearshore zone there are also occasional and sometimes extensive exposures of bedrock and boulder reefs, particularly off the Northumberland Coast. Here, limestone reefs extend into the sublittoral as bedrock platforms. Around the Farne Islands, igneous rock extends into deeper water, forming discrete bedrock outcrops. Softer shales are present further south off the coasts of Cleveland and North Yorkshire.

As a result of this mosaic of different sediment types there are a wide variety of habitats found on the seabed of this region. Sediments are generally classified by either the Folk (1954) or Wentworth (1922) systems (the Wentworth scale divides the Folk classes into

smaller fractions – see Appendix 3). The habitats below are described using a modified version of the terms of the Folk classification, since more detailed information of the seabed sediments is currently unavailable for the whole of the Marine Natural Area. As different types of sediment grade into one another, separating gravel, sand and mud habitats (as we have done here) is simply a means of dividing up what is a continuum. An exception to this is the 'muddy gravel' which, in terms of ecology, is closer to mud rather than gravel habitats and is therefore included with the former. One outcome of using the Folk classification is that areas defined as gravel by the British Geological Society may include cobbles, boulders, pebbles and granules (see Appendix 3). Stable aggregations of boulders and cobbles may be considered to constitute reef habitat (for example under the Habitats Directive, Johnston *et al* 2002) and this is reflected in the text.

The JNCC have developed the Marine Nature Conservation Review (MNCR) biotope classification system (Connor *et al* 1997)[6] which has been used here to describe the biological characteristics of each habitat type. The MNCR standardised the description of benthic communities throughout the UK and this provides a framework for assessment and future surveys. The biotope classification takes into account not only the most dominant species present but also the substrata, currents and other physical factors known to have an influence on the communities present.

4.2.1 Gravel habitats

The particle structure of these habitats ranges from various combinations of sand and gravel to pure gravel (Figure 4.1). The diversity and types of community associated with this habitat type are determined primarily by the sediment type, and also a variety of other physical factors such as the relative exposure of the coast, and differences in the depth, turbidity and salinity of the surrounding water.

Sublittoral sand and gravel sediments are the most common habitats found below the low water mark around the coast of the UK (UK Biodiversity Group 1999)**.** North Sea sands and gravels tend to be formed from rock material, whereas those off the west coast of the UK are largely shell-derived. While very large areas of seabed are covered by gravel in various mixes, much of this Natural Area has only very thin deposits over bedrock, glacial drift or mud.

The gravel habitats found in deeper offshore areas (>30 metres) generally tend to be less perturbed by natural disturbance than those found closer inshore. They are also more likely to support a diverse marine fauna that may include a wide range of anemones, polychaete worms, bivalves and amphipods, and both mobile and sessile epifauna. In defining the major fauna communities of the North Sea, Kingston and Rachor (1982) identified the mixed sand and gravel areas as being characterised by *Venus* bivalve communities. Of the biotopes identified in the MNCR, several may be found in the gravel substrata in this Natural Area (see Table 4.1).

[6] At the time of writing, JNCC were revising the classification. Latest updates can be seen at www.jncc.gov.uk/marine/biotopes/default.htm

4.2.1.1 Nature conservation measures

Gravel habitats are covered by a priority Habitat Action Plan[7] for sublittoral sands and gravels (UK Biodiversity Group 1999).

However, no provision for gravel habitats is made under the Habitats Directive. They do not meet the definition of 'Sandbanks which are slightly covered by seawater all the time' given under the Directive, since this habitat is restricted to sediments which predominantly comprise sand (0.0625-2 millimetres). However, some gravel habitat may meet the definition of 'Reefs' under the Directive, where they are predominantly composed of stable boulders and cobbles, as these can form a reef-like structure.

At present, all marine candidate Special Areas of Conservation (which form part of the Natura 2000 network) are adjacent to the coast. Work is underway to identify offshore sites both beyond 12 nautical miles (see Johnston *et al* 2002), and within English territorial waters. Preliminary work has been undertaken to derive areas of seabed which contain qualifying habitat. Within this Natural Area the qualifying habitat constitutes the scattered areas of 'pure' gravel shown in Figure 4.1. Further work is being undertaken to verify and refine these areas, eg to identify reef and reef-like habitat within areas of rocky or gravelly seabed. Prior to identification of proposed Natura 2000 sites, locations supporting relevant features of interest should be treated with care to ensure that they are not damaged or altered in such a way that might affect their selection as Natura 2000 sites. However, other than for boulder/cobble components of gravel habitat, there will be no sites identified for gravel since it is currently omitted from the Habitats Directive.

See Table 4.2 for a summary of the conservation measures.

4.2.2 Sand habitats

Sands are widespread throughout this Natural Area and are the dominant habitat type found within the Mid North Sea Marine Natural Area (Figure 4.2). Due to their particle size, sands in moderate to strong currents are mobilised whereas finer muds and clays remain in suspension. Stronger currents produce seabed sediments of clean sand (and occasionally shell fragments) with little mud or silt. More mobile sand habitats tend to be characterised by robust and sometimes impoverished faunas. Venerid bivalves, amphipod shrimps and polychaete worms are particularly characteristic (see Table 4.1 for MNCR biotopes). Organisms capable of rapid burrowing, such as certain mobile polychaetes and thick-shelled bivalves, often dominate such habitats. Fine, compacted sands exposed to moderate wave action and weak tidal streams (such as those areas present offshore within this Natural Area) are likely to be characterised by the thin-shelled bivalve *Fabulina fabula*. Generally, sands in deeper water can support more delicate species which are more vulnerable to physical damage.

The communities which these sand areas support are determined by a number of factors. These include the exact nature of the sediment, the relative exposure of the coast and differences in depth, turbidity, and salinity of the surrounding water. In inshore areas, shallow sandy sediments are typically colonised by a fauna of worms, crustaceans, bivalve molluscs and echinoderms. These areas also provide important nursery grounds for young

[7] A Habitat Action Plan is a document which describes the current status of a particular habitat, gives costs and targets for its restoration, management or creation, and is endorsed by the UK Biodiversity Group

commercial fish species, including plaice *Pleuronectes platessa*, cod *Gadus morhua* and Dover sole *Solea solea* (Brown *et al* 1997).

Gravelly sand areas can be colonised by the Ross worm *Sabellaria spinulosa* which can aggregate sediment together to a form reef-like structure, but more commonly in this Natural Area they form thin crusts. *Sabellaria* reefs are considered in other Natural Area profiles where the habitat occurs. Sand and muddy sand areas around Lindisfarne are colonised by *Zostera* (seagrass) species which is described in section 4.2.5.1.

4.2.2.1 Nature conservation measures

Sand habitats are covered by a priority Habitat Action Plan for sublittoral sands and gravels (UK Biodiversity Group 1999).

The Habitats Directive includes the habitat 'Sandbanks which are slightly covered by seawater all the time'. In the UK this has been interpreted as comprising a range of sandy sediments (particle size range 0.0625-2 millimetres and where sand is dominant), on distinct banks which may arise from horizontal or sloping plains of sandy sediment. Water depth for this habitat is seldom more than 20 metres below chart datum (European Commission 1999), so it excludes deeper relict sandbanks. Thus shallow sandbanks and mounds may be designated as SACs but large, flat areas of sand habitat may not be selected. None of the areas of sand habitat in less than 20 metres of water within the Mid North Sea Marine Natural Area (Figure 4.3) has been selected for designation for this feature. However, the Habitats Directive also includes the habitat 'Large shallow inlets and bays' which can encompass areas of sand habitat. This is an interest feature of the Berwickshire and North Northumberland Coast SAC. See Table 4.2 for a summary of conservation measures.

At present, all marine candidate Special Areas of Conservation (which form part of the Natura 2000 network) are adjacent to the coast. Work is underway to identify offshore sites both beyond 12 nautical miles (see Johnston *et al* 2002), and within English territorial waters. Preliminary work has been undertaken to derive areas of seabed which contain qualifying habitat and this is shown in Figure 4.3. Further work is being undertaken to verify and refine these areas, eg sandbanks within the broad swathes of shallow sandy seabed. Prior to the identification of proposed Natura 2000 sites, locations supporting relevant features of interest should be treated with care to ensure that they are not damaged or altered in such a way that might affect their selection as Natura 2000 sites.

4.2.3 Mud habitats (including muddy gravel)

The presence of mud mixed in with other sediment types usually indicates an area of relative shelter from wave exposure or from tidal currents. It is under such conditions that silt can settle onto the sea floor and become incorporated into the sediments. Because of the exposed nature of much of this Natural Area, few areas of mud-dominated sediment can be found except in deeper water such as in 'troughs' or 'deeps' (Figure 4.4). Polychaete worms, bivalve molluscs and brittlestars often dominate these muddy sediments.

The JNCC Marine Nature Conservation Review (MNCR) biotope classification scheme (Connor *et al* 1997) identifies a number of biotopes which may be found in association with the small area of mud habitat in this Natural Area (see Table 4.1).

4.2.3.1 Nature conservation measures

Two types of mud habitat are covered by Habitat Action Plans ,'Sheltered muddy gravels' and 'Mud habitats in deep water'. However, the former primarily covers muddy gravels in estuaries, rias and sea lochs which do not occur in this Natural Area. The latter Action Plan applies to mud habitats below 20 to 30 metres depth, which includes some of the habitat occurring in this Natural Area. Subtidal mud habitat is not listed on the Habitats Directive but may be included as a constituent of 'Large shallow inlets and bays' habitat. Whilst the Berwickshire and North Northumberland Coast SAC is designated for this feature, most of the bays are characterised by clean sand.

4.2.4 Rock habitats

Rock habitats include exposed areas of bedrock, which have a flat profile or rise from the seabed to form, together with stable areas of boulders and cobbles, reefs or reef-like habitats (often containing sea caves). The diversity of rock habitats is of considerable conservation importance as they often support sites of high biodiversity (Hill *et al* 1998). Different types of rock, such as limestone or sandstone, also have an effect on biotope type.

4.2.4.1 Reefs

The term reef is generally used to refer to an area of rock habitat that arises from the surrounding seabed, although it has a specific definition under the Habitats Directive. The communities that are found on reefs and reef-like habitats depend on a number of factors including the rock type, depth, exposure to wave action and tidal streams, and turbidity. In shallow water, light intensity is sufficient to allow for the growth of dense forests of kelp. In deeper water, where light intensity is lower, communities become animal-dominated, often with turfs of bryozoans and hydroids, sponges and sea squirts.

Reef habitats within this Natural Area are moderately exposed to wave action and only occur close to the shore in the shallow sublittoral (Figure 4.5). Together with those found in the intertidal, they form the most diverse examples of reefs on the North Sea coast (Brown *et al* 1997). A large number of the species present are characteristic of cold water, such as the anemone *Bolocera tuediae* and the bottlebrush hydroid *Thuiaria thuja*. However, some species reach their northernmost limit (on the east coast of Britain) within the Natural Area, such as the Devonshire cup coral *Caryophyllia smithii*.

Along the Northumberland Coast, rock platforms extend away from the coast as a series of reefs and rocky plains. These platforms extend several kilometres out to sea as a series of underwater terraces (English Nature 2000). Although this part of the coast is exposed to the full fetch of the North Sea (from the east or north east), the wave action is rapidly reduced on the extensive rocky platforms, allowing a wide range of animal and plant communities to thrive. On the Farne Islands, shallow sublittoral rock supports extensive kelp forests which are heavily grazed by the sea urchin *Echinus esculentus*. Vertical rock is covered by the tubeworm *Pomatoceros triqueter*, and in areas of tidal movement, the soft coral *Alcyonium digitatum* is abundant.

The JNCC Marine Nature Conservation Review (MNCR) biotope classification scheme (Connor *et al* 1997) has identified a number of biotopes which are associated with rocky habitats in this Natural Area (see Table 4.1).

4.2.4.2 Sea caves

The UK has the most varied and extensive sea caves on the Atlantic coast of Europe (Brown *et al* 1997). Caves can vary in extent, from only a few metres to more extensive systems that extend several tens of metres into the rock. There may be tunnels or caverns with one or more entrance, in which the vertical and overhanging rock faces provide the principal habitat. Sea cave communities vary considerably, depending on the structure and extent of the cave system, their degree of submergence and of exposure to scour and surge, and the nature of the geology. Caves are typically colonised by encrusting animal species but may also support shade-tolerant algae near their entrances.

The sea caves within this Natural Area are mostly found along the Northumberland Coast (Figure 4.3) though further examples also occur around Whitby. These are present both in the intertidal and the shallow subtidal and occur in a range of different types of rock. There are examples of partly submerged caves in the softer sandstone cliffs north of Berwick-upon-Tweed, in the limestone at Howick and on the north side of Lindisfarne. Submerged sea caves, tunnels and arches occur in the harder volcanic rock near the Farne Islands.

Caves that occur below Low Water Mark are continuously submerged and not exposed to the air at all. Environmental conditions in these caves are not as harsh or extreme as in intertidal sea caves and therefore tend to support a wider range of species. Subtidal sea caves are subject to less water movement from the surrounding sea than intertidal caves and, where there is sufficient shelter from waves or currents, silt may accumulate on the cave floor. Sponges, soft corals, solitary sea squirts, bryozoans and sessile larvae of jellyfish are characteristic of deeper cave communities. Caves such as these provide an important shelter for crustaceans such as crabs and lobsters *Homarus gammarus*, and for a wide variety of reef-dwelling fish such as the leopard-spotted goby *Thorogobius ephippiatus*. A summary of the biotopes associated with the subtidal cave communities present within this Natural Area is given in Table 4.1.

4.2.4.3 Nature conservation measures

There are no priority Habitat Action Plans for the rock habitats that occur within this Natural Area. The Habitats Directive includes two rock habitat types for which SACs can be designated: 'Reef' and 'Submerged or partially submerged seacaves'. The Berwickshire and North Northumberland Coast SAC has been selected for both features.

At present, all marine candidate Special Areas of Conservation (which form part of the Natura 2000 network) are adjacent to the coast. Work is underway to identify offshore sites both beyond 12 nautical miles (see Johnston *et al* 2002), and within English territorial waters. Prior to the identification of proposed Natura 2000 sites, locations supporting relevant features of interest should be treated with care to ensure that they are not damaged or altered in such a way that might affect their selection as Natura 2000 sites. However, it is unlikely that further SACs for reefs or sea caves will be selected due to their scarcity beyond the coastal fringe of this Marine Natural Area. A summary of conservation measures is given in Table 4.2.

4.3 Notable biogenic habitats

Animals and plants can have a profound influence on the habitats in which they reside, for example the presence of large numbers of kelp plants on flat bedrock makes for a very different habitat to bare flat bedrock. In this section, a small number of biogenic habitats are highlighted. This reflects their nature conservation importance but also demonstrates that there are habitats in the seas around England that are formed by plants and animals rather than their classification simply being based on the seabed substrata.

Particular biogenic habitats are often associated with specific broad habitats, for example, maerl is usually associated with "gravel", seagrass beds with "sand", though reefs formed by animals such as the ross worm *Sabellaria* spp. can be associated with a range of habitats such as gravel, pebbles and cobbles, and bedrock.

4.3.1 Seagrass beds

Seagrasses grow in shallow coastal areas, often forming dense underwater meadows. These productive and diverse habitats provide shelter and food for a variety of other species. They also provide food for wildfowl and shelter the juvenile stages of a number of commercially important fish. Being in the coastal zone, they are increasingly threatened by human pressures.

There are two (possibly three[8]) species of the seagrass *Zostera* which occur in the UK, although only one, *Z. marina*, is predominantly subtidal. Commonly referred to as eelgrass, *Z. marina* is the largest of the seagrass species and occurs just below Low Water Mark, on fine to coarse sand which may also have flint gravel mixed with it. Much of the seagrass in this Natural Area has been found in the intertidal zone around Lindisfarne.

4.3.1.1 Nature conservation measures

Seagrass beds are covered by their own Habitat Action Plan but are also indirectly covered by the HAPs for other "host" habitats, such as sublittoral sands and gravels, mudflats and saline lagoons (Brown *et al* 1997).

In relation to the Habitats Directive, sandbanks which are vegetated by seagrass *Zostera* spp. are included as a sub-type of the habitat 'Sandbanks which are slightly covered by sea water all the time'. These are a feature of the Berwickshire and North Northumberland SAC.

At present, all marine SACs (which form part of the Natura 2000 network) are adjacent to the UK coast. Work is underway to identify offshore sites, both in offshore waters (see Johnston *et al* 2002) and in English territorial waters. However, it is unlikely there would be any such sites supporting seagrass beds beyond the SACs already identified within the Mid North Sea Natural Area.

[8] The other two species are *Zostera noltii* and *Zostera angustifolia*. However, it has been thought for some time that *Z. angustifolia* (found intertidally) is just a different growth form of *Z. marina* (see Davison & Hughes 1998). Latest developments in the taxonomy of this genus is the recognition of two varieties of *Z. marina*: var. *stenophylla* and var. *marina* (pers. comm., Chris Davis, English Nature).

Table 4.1 MNCR biotopes (Connor *et al* 1997) associated with the key habitats in the Mid North Sea Natural Area.

Key habitat	Biotope description (and code)
Gravel habitats	Venerid bivalves in circalittoral coarse sand or gravel (CGS.Ven and CMX)
Sand habitats	Shallow sand faunal communities (IGS.FaS), circalittoral muddy sands (CMS)
Mud habitats	Circalittoral mud (CMU) Seapens and burrowing megafauna (SpMeg)
Rock habitats	*Sabellaria spinulosa* and *Polydora* spp. on stable circalittoral mixed sediment (CMX.SspiMx) Kelp with cushion fauna, foliose red seaweeds or coralline crusts (exposed rock) (EIR.KfaR) Robust faunal cushions and crusts (surge gullies & caves) (EIR.SG) Kelp with red seaweeds (moderately exposed rock) (MIR.KR) Grazed kelp with algal crusts (MIR.GzK) Sand or gravel-affected or disturbed kelp and seaweed communities (MIR.SedK) Fauna and seaweed (shallow vertical rock) (IR.FaSwV) *Alcyonium*-dominated communities (tide-swept/vertical) (ECR.Alc) Moderately exposed circalittoral rock (MCR) Soft rock communities (MCR.SfR) Sponge crusts and anemones on wave surged vertical infralittoral rock (SCAn) Sponge crusts, anemones and *Tubularia indivisa* in shallow infralittoral surge gullies (SCAn.Tub) Sponge crusts and colonial ascidians on wave surged vertical infralittoral rock (SCAs) *Dendrodoa grossularia* and *Clathrina coriacea* on wave surged vertical infralittoral rock (SCAs.DenCla) Sponge crusts, colonial (polyclinid) ascidians and a bryozoan/hydroid turf on wave surged vertical or overhanging infralittoral rock (SCAs.ByH)

Table 4.2 Summary of nature conservation measures.

Habitat type	**EU Habitats Directive [1]**				**UK Biodiversity Action Plan[2]**			
	Sandbanks which are slightly covered by seawater all the time [a]	Sea caves[a]	Large shallow inlets & bays[a]	Reefs [a]	Sublittoral sands and gravels	Sheltered muddy gravel	Mud habitats in deep water	Seagrass beds
Gravel habitats			●	● boulders and cobbles	●			
Sand habitats	●		●		●			
Mud habitats			●			●	●	
Reefs				●				
Sea caves		●						
Seagrass beds	●							●

1 'Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora' is commonly known as the Habitats Directive.

a Annex I natural habitat of community interest whose conservation requires the designation of Special Areas of Conservation

2 The UK Government's plan for the protection and sustainable use of biodiversity, published in 1994. It represents a commitment to joint action nationwide through the securing and better use of resources.

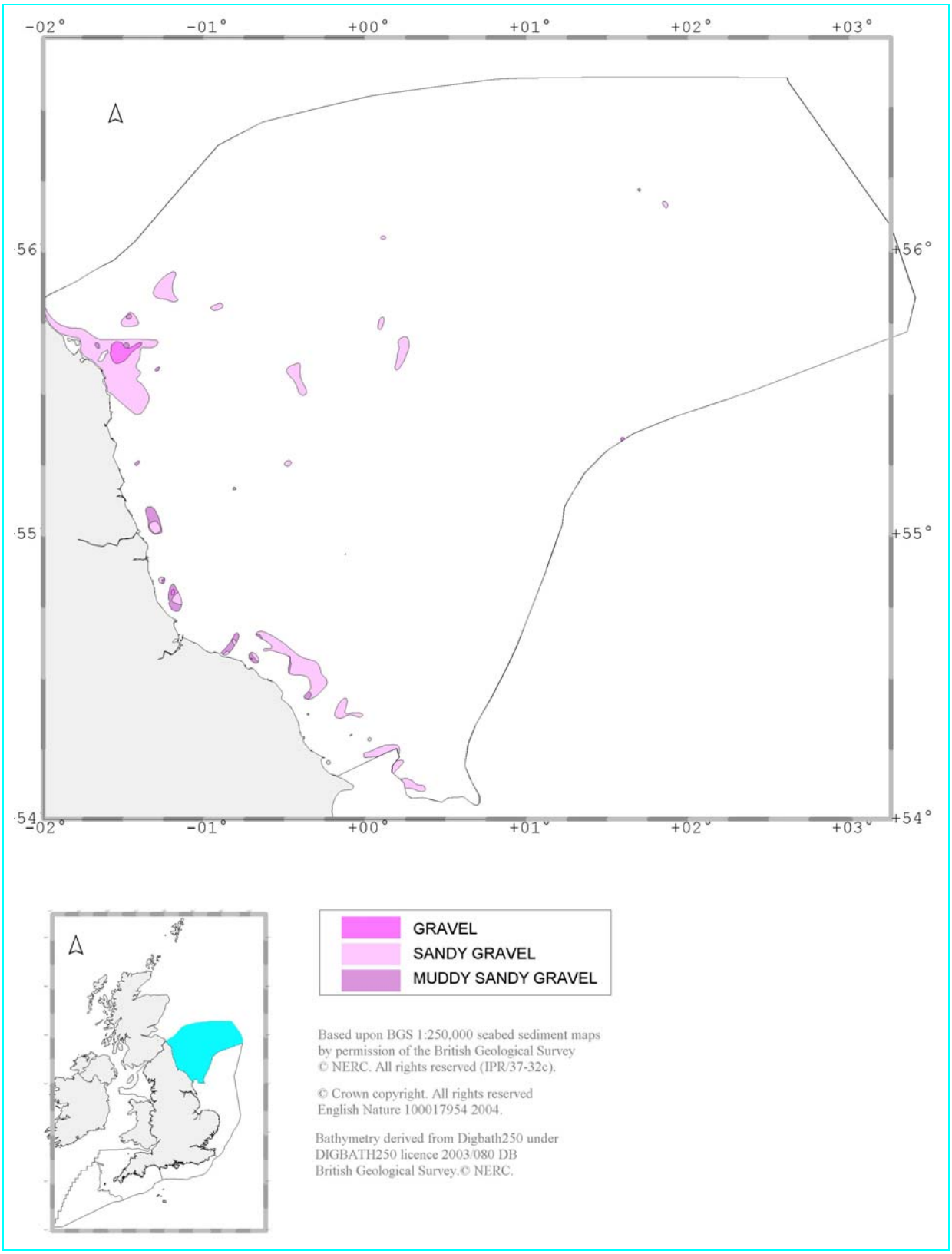


Figure 4.1 Gravel habitats in the Mid North Sea Natural Area.

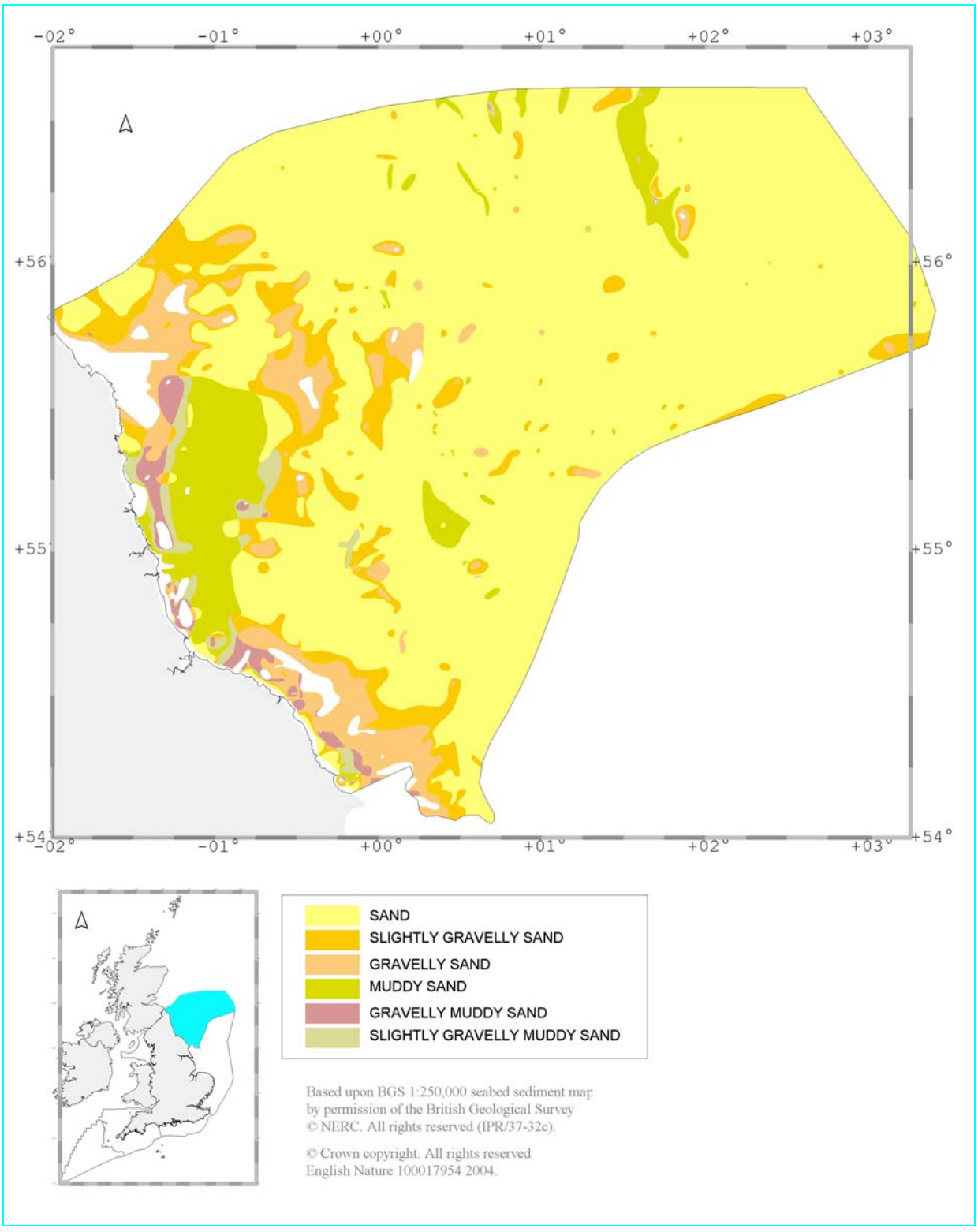


Figure 4.2 Sand habitats in the Mid North Sea Natural Area.

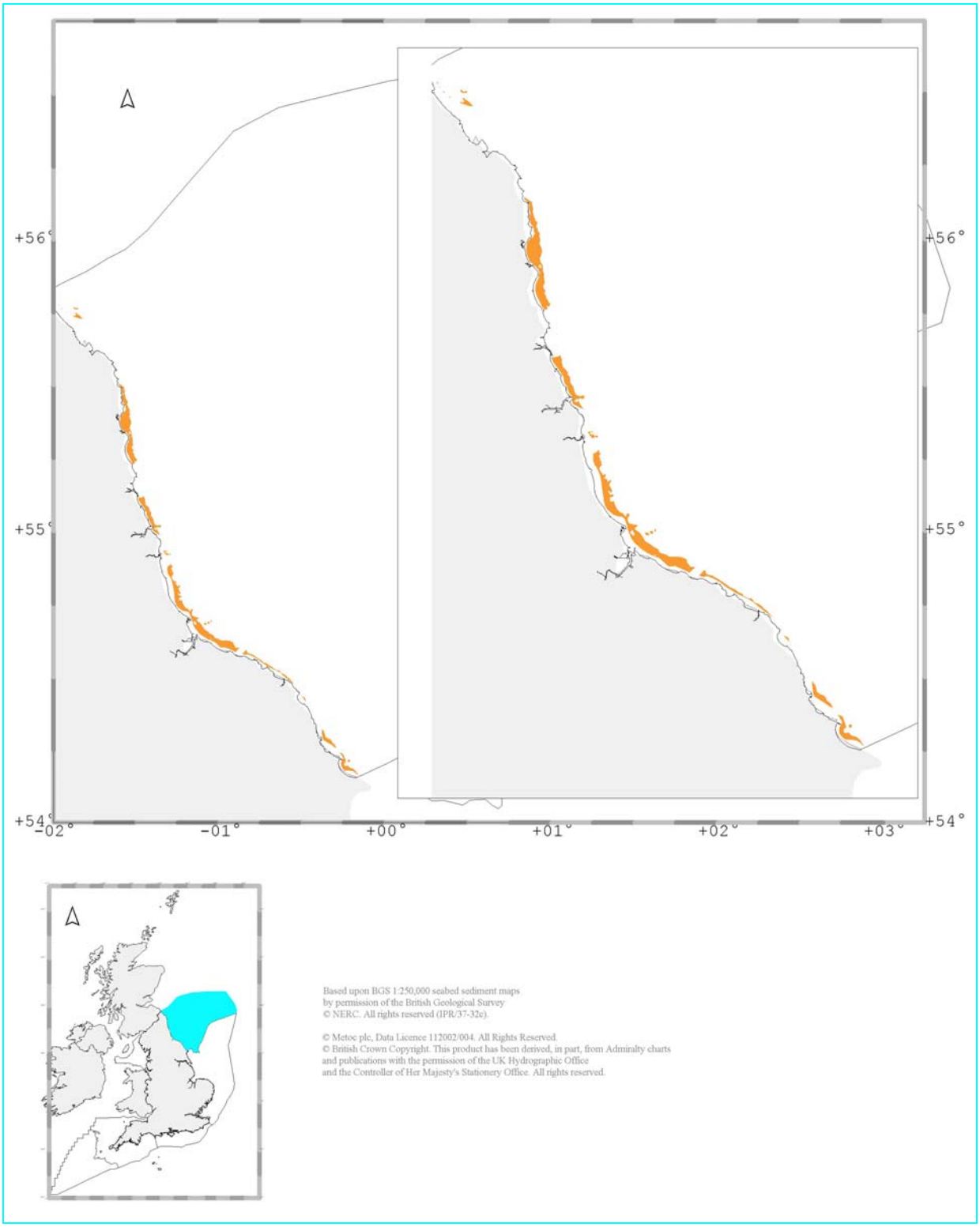


Figure 4.3 The distribution of shallow (<20 metres) sandy seabed areas which indicate the potential location of 'Sandbanks which are slightly covered by sea water all the time' (*sensu* Habitats Directive) in the Mid North Sea Natural Area. Further refining of these areas will define seabed which qualifies as Habitats Directive habitat.

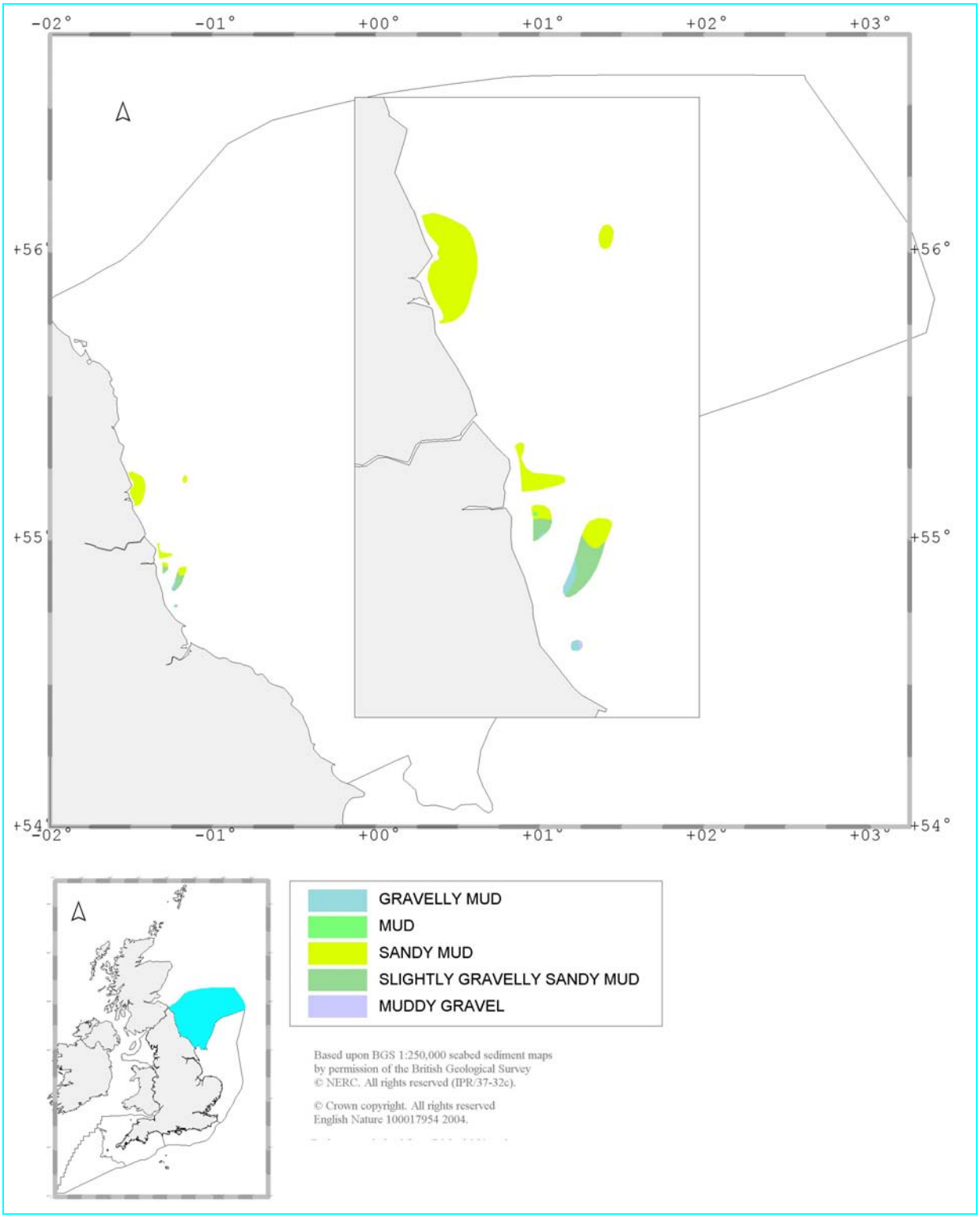


Figure 4.4 Mud habitats in the Mid North Sea Natural Area.

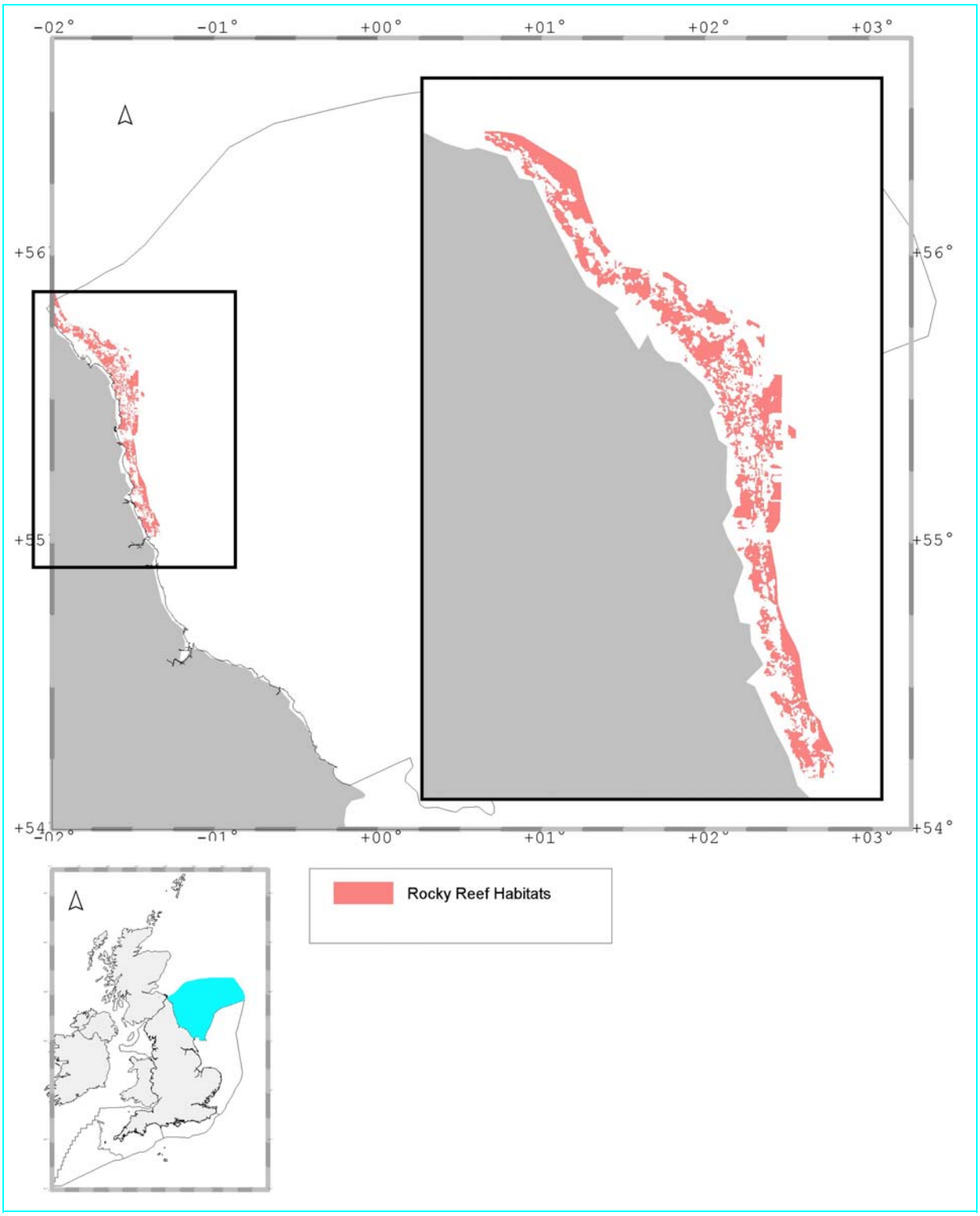
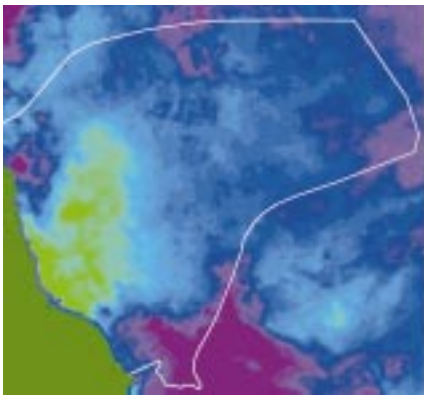
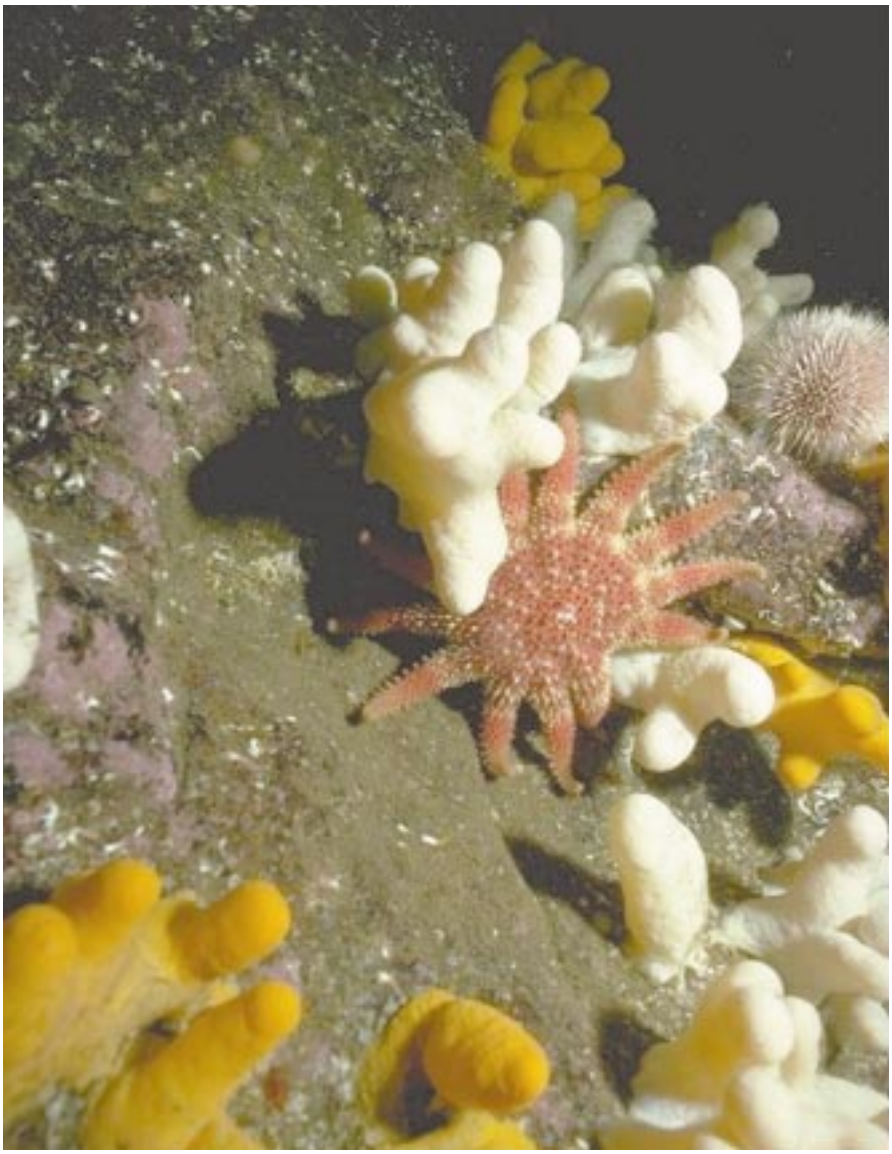


Figure 4.5 Rocky habitat, based on distribution of reefs, in the Mid North Sea Natural Area (Data taken from English Nature 2000).

Mid North Sea

Soft coral, keel worms and the common sunstar on circalittoral rock at Berwick, Northumberland.
Jon Davies/JNCC (right)

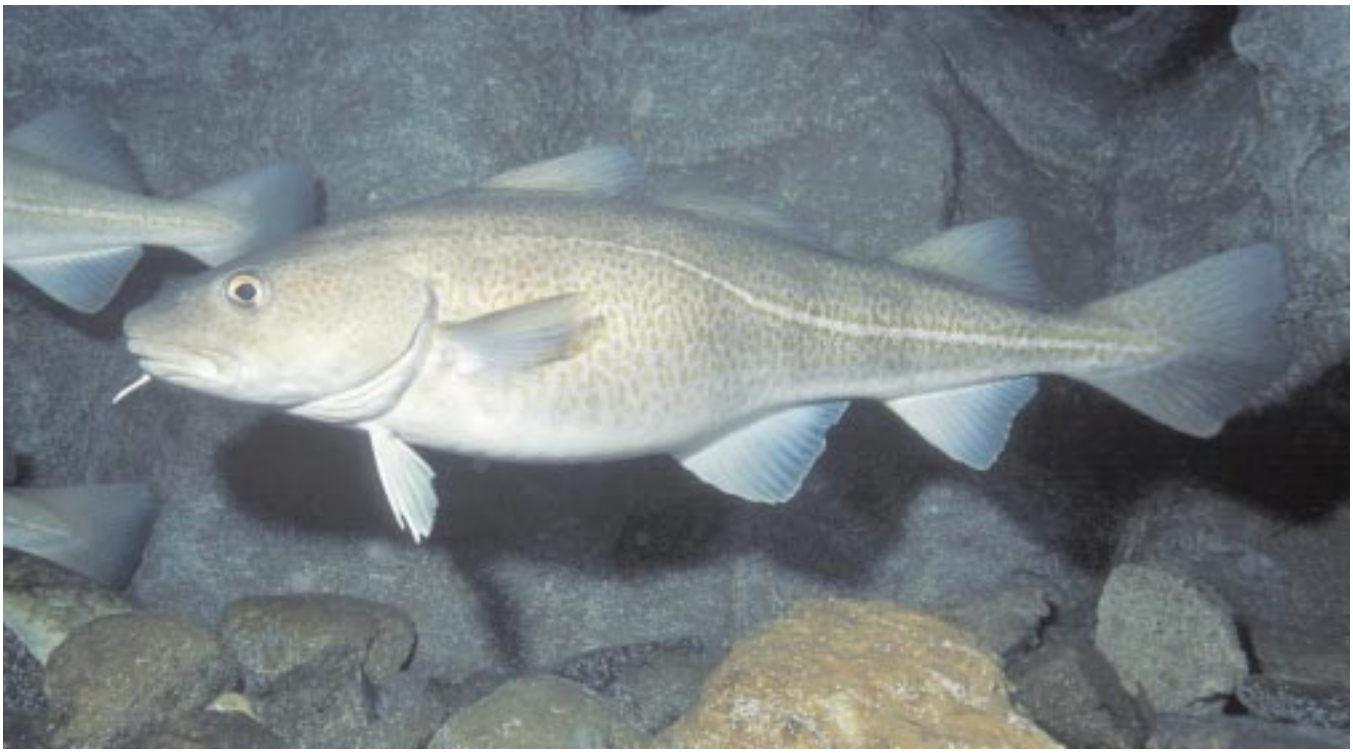




Aerial photograph of Inner Farne Islands, Berwickshire in 1994. English Nature (topleft)

Seawater surface temperature for Mid North Sea in June 1997. © Natural Environment Research Council (NERC) & Plymouth Marine Laboratory (PML) 2004 (middle left)

Kittiwake on cliffs at Flamborough Head and Bempton Cliffs Special Protection Area which holds one of the largest kittiwake colonies in the world. English Nature (left)



Cod is one of the most important commercial fish in the Mid-North Sea, spawning occurs extensively in the area offshore from Flamborough Head.
Paul Kay/Marine Wildlife Photo Agency (above)

Blyth offshore windfarm which when first constructed had the largest offshore turbines in the world.
AMEC Border wind (above)

Oil rig in Mid North Sea.
©Crown Copyright 2001 (above)

Bottlebrush hydroid, a cold water species reaching its southern most limit of distribution within this Natural Area.
Bernard Picton/JNCC (left)

5 Key species

This section describes key species of nature conservation value in the Mid North Sea. We have used the UK Biodiversity Action Plan (BAP) and the Habitats and Birds Directives as a focus and basis for structuring the text. Hence, for example, whilst a number of the fish species described are of commercial importance, they are included here because they are covered by Species Action Plans under the UK BAP. The main conservation measures currently in place are noted for each group of species, to indicate the effort being made towards their protection.

5.1 Marine birds

5.1.1 Background

The UK's coastal and offshore waters are of exceptional importance for several species of resident and migratory marine birds [9]. For example, of the 25 species of seabird which regularly breed in the UK, 17 are present in UK waters in numbers greater than 50% of the EU population (Lloyd *et al* 1991).

The distribution of marine birds is influenced by a wide-variety of factors. Perhaps the most important of these is food availability (Hunt & Schneider 1987), though proximity to suitable nesting habitat is of crucial importance throughout the breeding season (Skov *et al* 1994).

Fish are the main prey for the majority of marine bird species. Among the most important are sandeel (Ammodytidae), herring *Clupea harengus*, sprat *Sprattus sprattus* and mackerel *Scomber scombrus* (Skov *et al* 1995). The larvae of many of these species feed on plankton and occur at high densities where plankton is abundant. Such conditions occur at fronts, where deeper, nutrient-rich waters mix with warmer, sunlit surface waters (Lloyd *et al* 1991; Pingree *et al* 1975). The abundance of food at fronts attracts both fish and marine birds (see for example Stone *et al* 1995).

During the breeding season, the distance over which a nesting species will forage varies according to species. Northern fulmar *Fulmarus glacialis* may feed 400 kilometres or more from their breeding colony (Dunnet & Ollason 1982), whilst others, such as the black guillemot *Cepphus grylle*, rarely feed more than than a few kilometres offshore (Lloyd *et al* 1991). Outside the breeding season many species of seabirds disperse over a wider area.

[9] Marine birds include all birds that are wholly or partly reliant upon the sea. For the purpose of this document we have divided marine birds into two categories:

- True seabirds – birds reliant on the sea all year. These include terns, gulls, petrels, cormorants, auks, skuas and the Northern gannet.
- Coastal birds – birds reliant on the sea (open coasts as well as estuaries) for only part of the year. These include divers, grebes and seaduck.

Many species congregate at high densities to feed, nest and moult. In such situations a large proportion of the total population can be vulnerable to local incidents such as oil spillages. The majority of marine birds are long-lived and do not reach breeding condition for several years. For example, on average, fulmar do not breed until their ninth year and may live for at least another 35 years (Dunnet & Ollason 1978). Many marine birds also have low reproductive rates. Hence, even highly localised incidents can have a significant impact upon a population, particularly where adults are affected (Tasker *et al* 1990). Several species of marine bird, most notably the auks, divers, grebes and seaducks, moult their flight feathers simultaneously, becoming temporarily flightless. Such species are also particularly vulnerable at this time.

Predation can significantly affect breeding marine bird populations. The threats from predation are most severe for seabirds nesting on islands due to limited space, restricted available habitat and lack of effective anti-predator behaviour (Burger & Gochfeld 1990).

5.1.2 Distribution of marine birds

The Mid North Sea Natural Area is important for marine birds. Thirty two species that regularly occur here are indicated in Table 5.1, together with a summary of their status, distribution and abundance in the Natural Area.

Marine birds are unevenly distributed throughout the Mid North Sea Natural Area, both geographically and in time (Stone *et al* 1995).

The varied coastline adjacent to this Natural Area provides suitable nesting habitat for a wide range of marine bird species. Cliff grasslands, especially on offshore islands, are home to species including puffin *Fratercula arctica* and several species of gull and tern, whilst rugged cliffs, pinnacles and islands present ideal nesting conditions for fulmar, guillemot *Uria aalge* and razorbill *Alca torda*. Shag *Phalacrocorax aristotelis* tend to prefer the more gentle boulder-strewn slopes, whilst terns and gulls nest also on sparsely vegetated upper foreshore.

All of these birds rely upon the marine waters of the Natural Area to a greater or lesser extent for feeding, preening, mating and resting. The majority, including fulmar, gannet *Morus bassanus* and guillemot *Uria aalge*, occur within the Natural Area throughout the year. Other species, notably the terns, *Sterna* spp., are seasonally dependent on the area, migrating to more distant waters outside the breeding period.

Several species, including shearwaters, petrels and skuas pass through the Natural Area on migration. Large numbers of seaducks, divers and grebes migrate from their northern breeding grounds to over-winter in the shallow, productive waters of this Natural Area.

Away from inshore waters, marine birds feed, roost or fly over most areas of open sea in low numbers. Larger concentrations tend to occur only where food resources are both available and abundant. This includes areas of temporary abundance, eg in the vicinity of fishing vessels. During the breeding season nesting birds are also limited by distance from nesting grounds. Possibly the most influential feature away from the coast within the Natural Area is the 'Flamborough Front'. This forms the boundary between the Southern North Sea and Mid North Sea Natural Areas and provides a rich food source for a large number and diversity of seabirds. Relatively little is currently known of the spatial and temporal distribution of birds

across the Flamborough Front. In addition to the Flamborough Front, several temporary fronts of seasonal importance occur throughout the Natural Area.

5.1.3 Nature conservation measures

Six Special Protection Areas (SPAs) have been designated on the adjacent coastline for the internationally important marine bird populations that they support (see Figure 5.1). All the sites support internationally important concentrations of breeding terns. In addition, Teesmouth and Cleveland Coast SPA supports the largest known post-breeding concentrations of Sandwich tern in the UK.

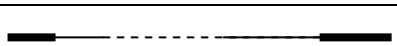
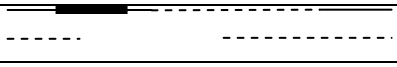
The cliffs adjacent to the Flamborough Front support a colony of seabirds of national and international importance, including the Flamborough Head and Bempton Cliffs SPA which has one of the largest kittiwake *Rissa tridactyla* colonies in the world - 25,000 pairs in 2000 - Mitchel *et al* (in prep). The SPA also supports the only mainland gannetry in England and substantial populations of puffin *Fratecula artica*, razorbill *Alca torda*, guillemot and fulmar. During the breeding season this site regularly supports over 300,000 individual seabirds (Stroud *et al* 2001).

Two further SPAs have been designated on account of their internationally important seabird communities (they regularly support >20,000 individual birds). The Farne Islands SPA regularly supports at least 142,290 individual seabirds including kittiwake, shag, cormorant, guillemot, puffin and four species of tern, whilst Coquet Island SPA regularly supports at least 33,448 individuals including black-headed gull, puffin and four species of tern. Furthermore, both SPAs support internationally important populations of puffin, the Farne Islands supporting 34,710 pairs and Coquet Island supporting 17,200 pairs. The Farne Islands are also of international importance for its population of breeding guillemot, supporting 23,449 pairs which represents 1% of the East Atlantic population (Stroud *et al* 2001).

Lindisfarne SPA also supports a diverse range of waterbirds and qualifies as an SPA by regularly supporting 41,870 individual wintering waterfowl, including eider and common scoter. Most of the Northumberland Coast is designated as SPA for birds which overwinter there, such as the purple sandpiper.

All of these sites are protected by the Birds and Habitats Directive, the Habitats Regulations and the Countryside and Right of Way Act 2001. Currently, the majority of SPAs extend no further seaward than Mean Low Water, although work is underway to identify additional marine areas that should be considered for designation. These sites will include areas where birds aggregate, eg for feeding and over-wintering. However, in the period prior to identification of proposed Natura 2000 sites, locations supporting relevant features of interest should be treated with care to ensure that they are not damaged or altered in such a way that might affect their selection as Natura 2000 sites.

Table 5.1 Summary of regularly occurring marine birds in the Mid North Sea Natural Area. This information has been compiled from a variety of sources including county avifaunas, county bird reports, Stone *et al* (1995), Lloyd *et al* (1991), Mavor *et al* (2001), Stroud *et al* (2001), Skov *et al* (1995) and Brown & Grice in press.

Species	Jan → Dec	Comments	Status
Red-throated diver		Main concentrations around Lindisfarne and Durham Coast.	PM, A1
Black-throated diver		As above.	PM, A1
Great northern diver		As above.	M, A1
Great crested grebe		Main concentrations off Lindisfarne, Durham coast and Teesmouth.	PM
Red-necked grebe		Key concentrations Bamburgh Ross – Lindisfarne.	M
Slavonian grebe		As above. Main concentrations around Bamburgh-Lindisfarne.	
Fulmar		Outside breeding season concentrations around the Flamborough Front and the Farne Deeps.	PM
Sooty shearwater		Counts from shore regularly >100 individuals per year with particularly high concentrations during adverse weather, eg 1,003 birds off Flamborough, Yorkshire 26 August 1978.	M
Manx shearwater		Key concentrations off Flamborough.	M
Storm petrel		Scattered distribution.	M, A1
Leach's petrel		As above.	M, A1
Gannet		Numbers peak post-fledging. Key concentrations areas off Flamborough Head.	PM
Cormorant		Principally coastal distribution.	PM
Shag		Main concentration centred on breeding colonies at Flamborough and Farne Islands.	PM
Eider		Local distribution. Highest densities in coastal areas, especially Coquet and Lindisfarne.	PM
Common scoter		Highest densities in sheltered, coastal zones.	PM
Pomarine skua		Mainly during passage between west Africa and north Russia, peaking in September.	M
Arctic skua		Scattered distribution during passage.	M
Long-tailed skua		Small scattering of birds during passage period.	M
Great skua		Highest densities Aug–Oct during passage.	M
Little gull		Coastal areas during passage.	M

Species	Jan → Dec	Comments	Status
Black-headed gull & common gull		Mainly coastal, throughout year.	PM
Lesser black-backed gull		Generally distributed throughout spring and summer..	PM
Herring gull & great black-backed gull		Highest densities Nov-Feb due to influx from Northern colonies.	PM
Glaucous gull		Scattered distribution.	M
Kittiwake		Highest densities along the southern and northern boundaries of the Natural Area, dispersing after breeding.	PM
Sandwich tern		Shallow areas adjacent to colonies. Migrate after breeding.	M, A1
Roseate tern		Shallow areas adjacent to breeding colonies on Farne Islands and Coquet Island. Migrate after breeding.	M, A1
Common, Arctic & little Tern		Shallow areas adjacent to colonies. Migrate after breeding.	M, A1
Guillemot & razorbill		High densities in the nearshore shallows and Frane Deeps. Disperse from colonies after breeding when family parties gather around the Flamborough Front.	PM
Little auk		Highest densities overall Nov-Feb. Key concentration Oct–Feb around the Flamborough Front.	M
Puffin			PM

Table notes:

Graded lines indicate relative seasonal abundance of a species.

- - - - Scattered or irregular
——— Present in small numbers
▬▬ Uncommon
▬▬ Common
▬▬ Abundant

Status: A1 = Listed on Annex 1 of Birds Directive.
M = Migratory
PM = Partially migratory species.

Names – bold type indicates species breed on adjacent shoreline.

5.2 Cetaceans

Cetaceans (whales, dolphins and porpoises) form a group of top predators in the marine environment. Those species which have been recorded for the Mid North Sea include large and small cetaceans and are divided into two suborders:

- **Baleen whales** (Mysticeti), which use plates of baleen (keratin) to filter out food from the water column.
- **Toothed whales** (Odontoceti), which have teeth. These include dolphin and porpoise species.

Cetaceans increase in diversity and abundance progressively northwards over the whole of the North Sea (Evans, 1995). Five species occur regularly within the Mid North Sea Natural Area and a further seven species have also been recorded. Their distribution and current status is discussed below.

Figure 5.2 shows where particular species of cetaceans have been sighted within the Natural Area over the period 1992-2001. Although very large, the data set used to compile the map does reflect the degree of observer effort and the location of observers such as ferries, coasts and offshore platforms. Therefore, it should only be considered as illustrative and not as a definitive picture of cetacean distribution in this area. A more qualified account is given by Reid *et al* (2003) which also includes an analysis of species abundance within a defined area. This work can be viewed at **www.jncc.gov.uk/publications/cetaceanatlas**.

5.2.1 Baleen whales

The minke whale *Balaenoptera acutorostrata*, occurs occasionally in small numbers within this Natural Area. It is seen along the Northumberland Coast and offshore, mainly between June and September. Minke whales are rarely seen in the North Sea before May and most sightings are within 100 kilometres of the coast. They usually occur singularly or in pairs (Evans 1995). The Sei whale *Balanenoptera borealis* has also been sighted in this Natural Area

5.2.2 Toothed whales

The commonest toothed cetaceans seen in nearshore waters within this Natural Area are the harbour porpoise *Phocoena phocoena* and the white-beaked dolphin *Lagenorhynchus albirostris*. Harbour porpoise occur in small numbers mainly off the Northumberland Coast (particularly around the Farnes and Holy Island), with peak numbers occurring in April and from July to November. Numbers of harbour porpoise in the North Sea may have declined over the last 50 years, although this observation relates particularly to the southern North Sea and English Channel (Doody *et al* 1993). The white-beaked dolphin is the commonest dolphin seen in these waters, though it occurs mainly offshore. Peak numbers and the most sightings are between June and September (particularly August) (Evans 1995).

The only other toothed cetacean which are is occasionally recorded from within the Natural Area is white-sided dolphin *Lagenorhynchus acutus* which is a deep-water species which favours the cool temperate and sub-arctic waters of the North Atlantic. It is mostly recorded more than 10 kilometres from the coast, with most nearshore sightings being to the north east of Flamborough Head, generally between July and September.

Other species of whales which have been recorded from the Natural Area include beluga *Delphinapterus leucas*, common dolphin *Delphinus delphis* and the bottlenose dolphin *Tursiops truncatus*.

5.2.3 Nature conservation measures

A summary of protection measures can be seen in Table 5.2.

All cetacean species found in this Natural Area are listed on either Appendix I or II of Convention on International Trade in Endangered Species (CITES). The former lists species that are the most endangered and therefore prohibits commercial trade and the latter lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled.

In addition to those protection measures listed in Table 5.2, there is an Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS). Formulated in 1992, this Agreement has been signed by eight European countries (including the UK) bordering the Baltic and North Seas (including the English Channel). Under the Agreement, provision is made for protection of specific areas, monitoring, research, information exchange, pollution control and increasing public awareness of small cetaceans.

All cetaceans are protected by the Bern Convention (1979) which conveys special protection to those species which are vulnerable or endangered. Although an international convention, in England it is implemented through the Wildlife and Countryside Act 1981.

The Bonn Convention (1979) protects migratory wild animals across all or part of their natural range through international co-operation, particularly those species that are in danger of extinction. One of the measures identified is the adoption of legally binding agreements of which ASCOBANS (described above), is one.

Under schedule 5 of the Wildlife and Countryside Act 1981 (as amended), all cetaceans are given full protection within British territorial waters. This protects them from killing or injury, sale, destruction of a particular habitat (which they use for protection of shelter), and disturbance. Common and bottlenose dolphins and harbour porpoises are also listed under schedule 6 of the Act which prevents these species being used as a decoy to attract other animals. This schedule also prohibits the use of vehicles to take or drive them, prevents nets, traps or electrical devices from being set in such a way that would injury them and prevents the use of nets or sounds to trap or snare them. Under the Countryside and Rights of Way Act 2001 is it an offence to deliberately or recklessly damage or disturb any cetacean in English and Welsh protected waters.

All toothed and baleen cetaceans are protected under Annex IV of the Habitats Directive because they are either endangered, vulnerable or rare. Harbour porpoise and bottlenose dolphin are also listed under Annex II of the Habitats Directive which requires Member States to designate SACs to ensure their conservation. However, no areas essential to life and reproduction have been identified for these species within this Natural Area.

Table 5.2 Summary of cetacean protection measures (see notes below for explanation of designations and abbreviations).

	Schedule 5 Wildlife & Countryside Act	EC Habitats Directive (Annex)	CITES (Appendix)	Bonn Convention (Appendix)	IUCN Red Data List Species	Bern Convention (Appendix)	UK Biodiversity Action Plan
Minke whale *Balaenoptera acutorostrata*	•	IV	I		LR nt	III	Baleen whales grouped plan
Sei whale *Balanenoptera borealis*	•	IV	I	II	EN	III	Baleen whales grouped plan
Harbour porpoise *Phocoena phocoena*	•	II IV	II	II	VU	II	Harbour porpoise Species Action Plan
White-beaked dolphin *Lagenorynchus albirostris*	•	IV	II	II		II	Small dolphins grouped plan
White-sided dolphin *Lagenorynchus acutus*	•	IV	II	II		II	Small dolphins grouped plan
Beluga *Delphinapterus leucas*	•	IV	II	II		III	
Common dolphin *Delphinus delphis*	•	IV	II	II			Small dolphins grouped plan
Bottlenose dolphin *Tursiops truncatus*	•	II IV	II	II		II	Small dolphins grouped plan

Table notes:

Annex IV EC Habitats Directive – This annex includes 'Animal and plant species of community interest in need of strict protection'. Under Annex IV the keeping, sale or exchange of such species is banned, as well as deliberate capture and killing.

CITES (Convention on International Trade in Endangered Species)
Appendix I - Prohibits the commercial trade of species included on this appendix.
Appendix II - Imposes strict regulation on the trade of species that may not necessarily be currently threatened with extinction.

IUCN Red List of Threatened Species - LR = Lower risk
VU = Vulnerable
nt = near threatened
EN = Endangered

Biodiversity Action Plan
This is the UK Government's response to Article 6 of the Convention on Biological Diversity (1994). The overall goal is to conserve and enhance biodiversity in the UK. A Species Action Plan provides detailed information on the threats facing species and the opportunities for maintaining and enhancing populations. A 'Grouped' Species Action Plan has been produced for baleen whales as a range of common policies and actions are required for all species listed.

5.3 Seals

The UK is home to between 97,900-123,000 grey seals *Halichoerus grypus*. This accounts for approximately 39% of the world population (Natural Environment Research Council 2003). Grey seals can be seen regularly throughout the Natural Area (typically in the nearshore zone), with approximately 3,600 individuals (or 75% of England's grey seal population) being present off the Northumberland Coast during the breeding season (Duck 1995). Common seals *Phoca vitulina* are present in two small established colonies, on Holy Island Sands and a slightly larger one in the mouth of the River Tees.

Grey seals divide their time between land (where they breed, moult and rest) and the sea (where they forage and rest). The Farne Islands colony is the eighth largest in the UK, producing around 1,050 pups annually. These Islands provide suitable sheltered and undisturbed habitat for pupping (which occurs during the autumn) and for moulting (which for most grey seals occurs during the spring). There is evidence to suggest that grey seals feed over a large area of the North Sea at varying times of the year (English Nature 2000). Tagging surveys have found that they make frequent visits to the Farne Deeps to fish, possibly for sandeels *Ammodytidae sp.,* an important part of the grey seal diet in the area (Sea Mammal Research Unit pers comm.) Other localities close to the Farne Islands, and that are characterised by gently sloping banks of gravelly sand, are also frequented by grey seals probably because these areas are the preferred habitat of sandeels. There is also a notable haul-out area (accommodating approximately 100 grey seals) on the sandbanks to the west of Holy Island (English Nature 2000).

The annual breeding season for grey seals at the Farnes extends from mid-September through to early December. Adult females spend approximately three weeks ashore or in the shallow waters near the shores, where the pups remain until weaned. Adult males may spend anything from a few days to nearly two months on breeding islands, attempting to mate when the females come ashore. Shore areas also provide an important habitat throughout the year for grey seals to haul-out or rest, particularly during the spring when all grey seals, except young born the previous year, are moulting.

5.3.1 Nature conservation measures

Grey seal and common seal are protected under Annex II of the Habitats and Species Directive which requires Members States to designate Special Areas of Conservation (SACs) for their conservation. Sites such as The Berwickshire and North Northumberland Coast candidate SAC, which support concentrations of grey and common seal and contains areas considered to be essential to their life and reproduction, lists this species as an interest feature. The SAC includes the Farne Islands which is the most important pupping area for grey seals on the east coast of England.

Grey seals are also listed on Annex V of the Habitats Directive, which requires their exploitation or removal from the wild to be subject to management measures. These measures are provided for within national legislation. Both the grey and common seals are listed under Appendix III of the Bern Convention. This Appendix requires appropriate and necessary legislative and administrative measures to ensure the protection of the listed species. Any exploitation of wild fauna must also be regulated in order to keep the populations out of danger.

The Conservation of Seals Act 1970 provides for closed seasons, during which it is an offence to take or kill any seal except under licence or in certain particular circumstances. For grey seals, the closed season is from 1 September to 31 December, and for common seals it is from 1 June to 31 August. Following the halving of the common seal population as a result of the phocine distemper virus in 1998, an Order was issued under the Act which provided year-round protection of both grey and common seals on the east coast of England. The Order was last renewed in 1999. A re-occurrence of the disease, albeit at a much smaller scale, occurred in 2002.

5.4 Fish

The North Sea in general is a very important area for populations of a number of commercial fish species, providing spawning grounds and nursery and feeding areas. Consequently it is an area of considerable importance to the fishing fleets of all countries bordering the North Sea. Fish are referred to here in terms of pelagic or demersal (ground fish) species. Pelagic species are generally found in shoals swimming in the mid-water, whereas demersal species are found living on or near the seabed. In the Mid North Sea Natural Area important commercial species include cod, haddock, lemon sole, whiting, plaice, monkfish/angler fish, brill, dabs, gurnard, skates/rays, halibut, sole and ling.

5.4.1 Pelagic fish

Mackerel *Scomber scombrus* used to be one of the most commercially important pelagic species within this Natural Area. Individuals can reach up to 60 centimetres in length and they feed on small fish as well as on plankton. Feeding intensity is usually greatest in summer, after spawning. Two stocks of mackerel are found in north west European waters, the western stock which spawns along the shelf edge west of Britain, and the North Sea stock which spawns in the central North Sea, including offshore parts of this Natural Area (Figure 5.3a). Seasonal immigrants from the western stock also occur in the North Sea. Spawning occurs within this Natural Area between May and August and the area is also important as a feeding ground during July to September.

Herring *Clupea harrengus* reach a maximum size of 40 centimetres and are widely distributed in the seas of the north eastern Atlantic shelf. This species typically lives in large shoals and the population can be divided into a number of distinct breeding stocks. Spawning and feeding grounds are present within this Natural Area. Spawning tends to occur nearer the coast, usually on the edge of sediment banks, during the autumn and winter months. The exact timing depends on the locality and the rate of drift of the herring larvae to shallow nursery areas (Figure 5.3b). Egg-laying takes place where there is coarse shell, grit and gravel, and the distribution of spawning grounds can be roughly equated with the distribution of known gravel deposits.

Two non-commercial species, twaite shad *Alosa fallax* and allis shad *Alosa alosa* are anadromous. This means that individuals hatch in freshwater, where they feed and grow for approximately five months, before heading downstream to the sea. These species are declining throughout the UK although they have been recorded within this Natural Area (Potts & Swaby 1993). The occurrence of shad during the autumn is noteworthy because most of the shad in the UK are recorded in spring (mostly during late April and May). The Atlantic salmon *Salmo salar* and the sea trout *Salmo trutta* are also anodromous and may be

found in the coastal waters of this Natural Area. They are known to spawn in six rivers within the locality: the Aln, Coquet, Tyne, Wear, Tees and Esk.

5.4.2 Demersal fish

Cod *Gadus morhua* is one of the most important commercial fish species in the North Atlantic and is widely distributed around Britain. The North Sea population is self-contained and largely independent of the other populations of the North Atlantic. In general the fish migrate south to spawning areas in winter, and in summer they are spread out over a wider area. The main, very extensive, spawning area occurs in an area offshore of Flamborough Head, with only part of it occurring within this Natural Area (Figure 5.3c). Spawning takes place between February and April, during which time eggs and larvae drift in among the plankton. After about two months the young fish become demersal (live on or near the seabed) and inhabit the nursery areas shown in Figure 5.3c. Cod have been traditionally caught by trawling, mainly from autumn to spring. They are also targeted by small beach boats and cobles using set lines. At present, the cod stock is at an all-time low (and has been for some time) and a fish stock recovery plan has been put in place.

Plaice *Pleuronectes platessa* is most often found on sandy substrata down to depths of 120 metres, but this species also occurs on muddy bottoms and gravel. Plaice are long-lived fish, reaching maturity after three years. Spawning takes place in well defined spawning grounds in early spring (Figure 5.3d). Juveniles stay close to the shore, gradually moving into deeper water as they grow. Plaice are mostly caught from spring through to autumn.

Dover sole *Solea solea* (also known simply as 'sole') is an important commercial species in the southern North Sea, though its range extends into the southern part of this Natural Area. In the North Sea it is at the northern limit of its north east Atlantic distribution. This species is particularly abundant in areas of muddy sand and fine sand where the polychaetes that it feeds on are also abundant. Dover sole spawn in the early summer (April to June), but there are no identified spawning areas within this Natural Area. Dover soles are mostly caught from early summer through to autumn.

The common skate *Dipturus batis* is widely distributed throughout European waters, but it is very scarce. Within the North Sea it is extremely rare and is only occasionally caught within this Natural Area.

5.4.3 Conservation measures

The Common Fisheries Policy (CFP) is the European Union's instrument for the management of fisheries and aquaculture. The CFP was created to manage a common resource and to meet the obligations set out in the Treaty of Rome. It provides the legal framework for the exploitation of living marine resources in EU waters and for those vessels registered in the EU fishing in non-EU waters. The CFP not only sets the framework for the allocation of fisheries resources amongst member states and their rights of access to community waters, but also allows the introduction of technical measures for the conservation of fisheries resources. The Commission for the European Community has exclusive rights to administer up to the High Water Mark. However, in practice they devolve authority to the UK Government (Defra) to manage the fisheries within the 12 mile limit of the UK and to control the activities of UK registered fishing vessels.

Under the Sea Fisheries Regulation Act 1966, the Sea Fisheries Committees (SFCs) of England and Wales are responsible for the management of fisheries within six nautical miles of mean High Water Mark. They also share responsibility for marine nature conservation. The SFCs have the power to introduce byelaws within this six nautical mile zone, and they enforce UK and EC fishery conservation legislation. Two SFCs operate within this Natural Area: the Northumberland SFC (from the England/Scotland border south to the Tyne/Tynemouth Pier); and the North Eastern SFC (from the Tyne/South Shields Pier south to Grimsby).

5.4.3.1 Total Allowable Catch and Quotas

One of the four components of the Common Fisheries Policy is the conservation and enforcement policy, which aims to set fishing activity at a sustainable level. An objective of the Conservation Policy is the sharing or allocation of resources to Member States. In order to regulate this, a system of Total Allowable Catches (TACs) and quotas has been implemented. TACs are agreed annually by the Council of Ministers for each protected species in waters administered by the CFP, and are divided so that each member state receives a percentage or quota of a TAC. It is difficult to break down the species quota by Natural Area, as quotas are given for waters within the ICES fishing areas and there is often overlap between these and Natural Area boundaries. However the 2004 quotas for the whole of the zone in which the North Sea (ICES fishing areas IV) quotas are allocated to can be seen in Table 5.3.

Table 5.3 Summary table of 2004 fishing quotas for the zones in which the North Sea is located. (As agreed by Council Regulation 2287/2003). (i) = EC waters.

Species	Zone	TAC (tonnes)	UK TAC (tonnes)
Mackerel *Scomber scombrus*	IIa(i), IIIa, IIIbcd(i), IV	545,500	1,331
Herring *Clupea harengus*	North Sea (North of 53° 30")	460,000	62,100
Sprat *Spratus spratus*	IIa(i), IV	257,000	9,035
Cod *Gadus morhua*	IIa(i), IV	27,300	10,631
Plaice *Pleuronectes platessa*	IIa(i), IV	61,000	16,486
Sole *Solea solea*	II, IV	17,000	729
Skates and rays *Dipturus batis*	IIa(i), IV	3,503	2,266

5.4.3.2 Technical measures

Mesh size

This is the most basic form of technical measure. This sets a minimum mesh size that may be used for nets in a particular area or fishery, thus permitting small and immature fish to pass through the net. This can be a very successful conservation measure, as it enables more fish to reach sexual maturity and become part of the spawning stock. In addition it avoids catching unmarketable fish that would be discarded. However, demersal fisheries often consist of mixed species of varying sizes. This can lead to immature fish of larger species being caught, such as cod.

Minimum Size (MS)

Another fisheries conservation measure is concerned with regulating the Minimum Size (MS) of fish. Fish not attaining the MS may not be retained on board or landed for sale and must be returned to the sea. The approach aims to discourage fishermen from targeting concentrations of juvenile fish and from using small mesh nets.

5.4.3.3 Sea Fisheries Committees' byelaws

Each Sea Fishery Committee is able to introduce byelaws within their districts for governing the management of sea fish and the marine environment. These cover regulations such as boat size, gear type as well as the dimensions and the size of fish and shellfish.

5.4.3.4 Other conservation measures

Closed areas

Closures of a fishery can be spatial or temporal. They can be total closures, where no fishing is permitted; seasonal closures, where fishing is suspended at particular times of the year; temporary closures, where fishing may be suspended at short notice; and selective closures, where only specific fishing gears are permitted. There are also prohibitions on all trawling for three miles out to sea from Whitby and from Filey (under the jurisdiction of the North Eastern SFC), and these have been in place for over 60 years (Rogers 1997). Their purpose is to limit fishing activity in the inshore areas where juvenile gadoids (mainly cod) gather before moving into deeper water, and also to provide a protected area to set pots and long lines.

Closure of areas to certain types of gear

Both the Northumberland SFC and the North Eastern SFC Districts have a ban on the use of purse seine nets or ring nets, or similar nets which are used for taking fish by encircling them. The North Eastern SFC also has a ban on the use of suction dredging (Rogers 1997).

Closures for reasons other than fisheries conservation

Many areas around the UK are closed to fishing activity for a number of reasons not related to fisheries conservation. Reasons range from the need to protect high security Royal Navy ports to ensuring safety near oil and gas installations. For example, within the Mid North Sea

Natural Area, there are safety exclusion zones (extending to a radius of 500 metres) for all fishing activity around operational oil and gas well heads.

Reduction in fishing effort

Many of the commercially exploited fish stocks are too heavily fished, and a reduction in fishing pressure is needed from both a biological and an economical point of view.

Following the reform of the Common Fisheries Policy, reductions in fishing effort to achieve a stable and enduring balance between fishing capacity and fishing opportunities have continued. These are detailed in Chapter III of the Council Regulation EC 2371/2002. Implementation of the reduction in the Community fleet capacity, in terms of tonnage and power, is provided in Council Regulation EC 1438/2003. In addition, a special incentive has been put in place (Council Regulation EC 2370/2002) for the period 2003 to 2006, to provide Member States with funds to co-finance the scrapping of fishing vessels to achieve the additional reductions in fishing effort resulting from recovery plans.

Fishing rights

Access rights to the waters around the UK also control the level of fishing activity. Access to fisheries in the six nautical mile belt of UK Territorial Seas is limited to UK vessels. Access by non-UK fishing vessels to the 6-12 nautical mile belt of the UK Territorial Sea is limited to nations with 'historic rights'. Within this Natural Area, the Netherlands have rights to fish for herring between 6-12 nautical miles, whereas Germany only has herring fishing rights between Whitby and Berwick. France and Belgium have rights to fish herring between Coquet Island and Berwick.

5.4.4 Nature conservation measures

A summary of the conservation measures can be seen in Table 5.4. Only three species found within this Natural Area are protected by the Habitats and Species Directive - the twaite shad *Alosa fallax* , the allis shad *Alosa alosa* and the Atlantic salmon *Salmo salar*. These species are listed on Annex II (species of community interest whose conservation requires the designation of special areas of conservation) . and Annex V (species of community interest whose taking in the wild and exploitation may be subject to management measures). The River Tweed has been designated as SAC for a number of fish species.

Both shad species are also listed on Appendix III of the Bern Convention which includes species for which appropriate and necessary legislative and administrative measures must be taken to ensure the protection of the wild fauna species. Any exploitation of wild fauna specified in Appendix III is regulated in order to keep the populations out of danger. Measures which should be taken include:

- closed seasons and/or other procedures regulating the exploitation;
- the temporary or local prohibition of exploitation, as appropriate, in order to restore satisfactory population levels;
- the regulation as appropriate of sale, keeping for sale, transport for sale or offering for sale of live and dead wild animals.

There is a grouped Species Action Plan for Commercial Marine Fish. This provides detailed information on the threats facing species and the opportunities for maintaining and enhancing populations. A 'Grouped' Species Action Plan was produced as a range of common policies and actions are required for a number of similar species. The Commercial Marine Fish action plan differs from others in that it is aimed at particular stocks rather than the individual species as a whole. Within this Natural Area, stocks of cod, herring, mackerel, plaice and sole are included in the plan. There is also a Species Action Plan for the common skate, the allis shad and the twaite shad.

Table 5.4 Summary of conservation measures in place to protect Mid North Sea fish species.

Species	EC Habitats Directive (Annex no.)	Wildlife & Countryside Act (schedule 5)	IUCN Red Data List Species	Bern Convention (Appendix III)	Biodiversity Action Plan
Common skate *Dipturus batis*			Endangered (Provisional)		Common skate Species Action Plan
Allis shad *Alosa alosa*	II & V	•		•	Allis shad Species Action Plan
Twaite shad *Alosa fallax*	II & V	•		•	Twaite shad Species Action Plan
Atlantic salmon *Salmo salar*	II & V				
Cod *Gadus morhua*					Commercial marine fish grouped Species Action Plan
Herring *Clupea harrengus*					Commercial marine fish grouped Species Action Plan
Mackerel *Scomber scombrus*					Commercial marine fish grouped Species Action Plan
Plaice *Pleuronectes platessa*					Commercial marine fish grouped Species Action Plan
Dover sole *Solea solea*					Commercial marine fish grouped Species Action Plan

Table notes:

Annex II EC Habitats Directive – This annex includes 'Animal and plant species of community interest whose conservation requires the designation of special areas of conservation,

Annex V EC Habitats Directive – This annex includes 'Animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures,

Bern Convention - Conveys special protection to those species which are vulnerable or endangered. Although an international convention, in England it is implemented through the Wildlife and Countryside Act 1981.

Biodiversity Action Plan - This is the UK Government's response to Article 6 of the Convention on Biological Diversity (1994). The overall goal is to conserve and enhance biodiversity in the UK. A Species Action Plan provides detailed information on the threats facing species and the opportunities for maintaining and enhancing populations.

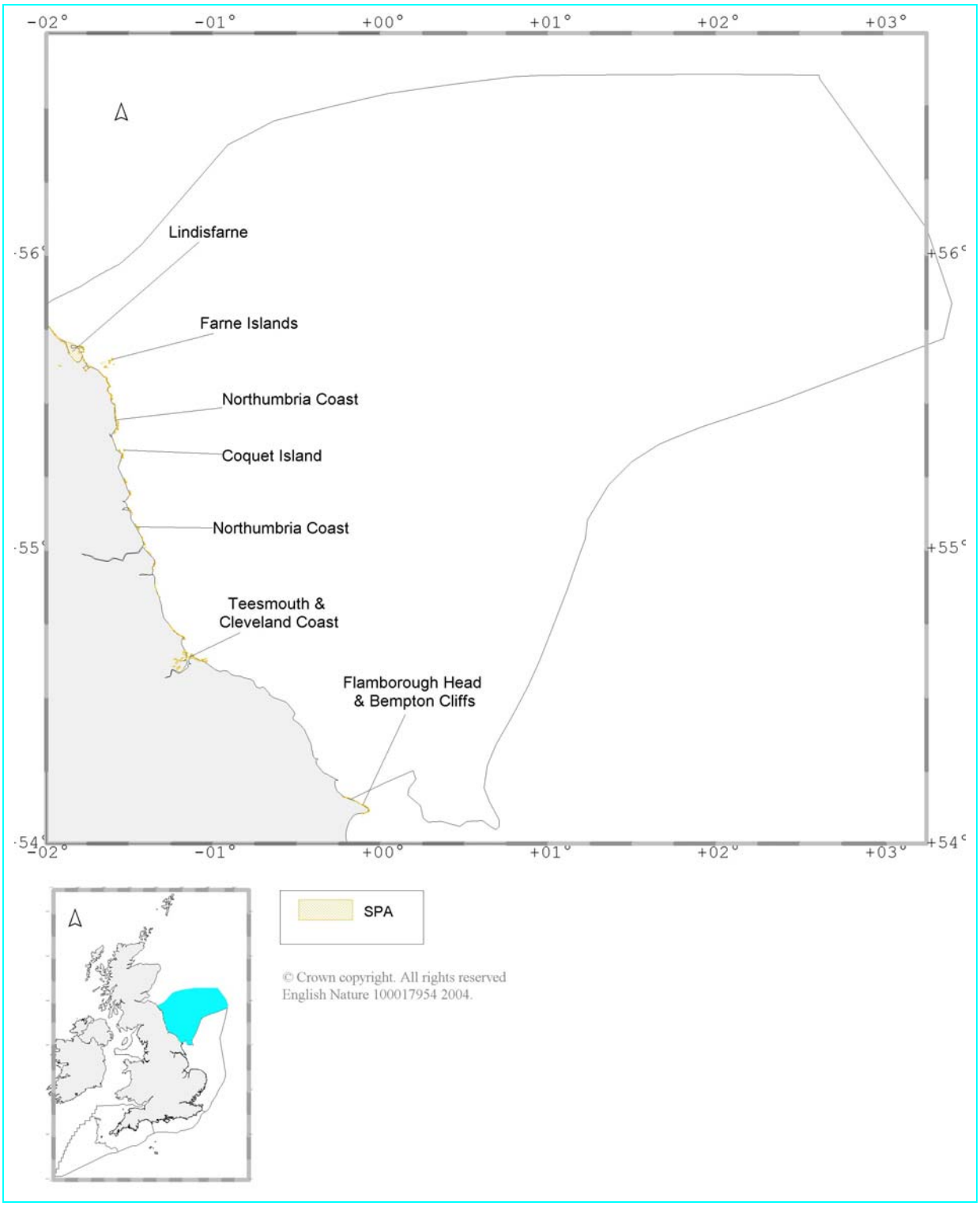


Figure 5.1 Special Protection Areas adjacent to the landward boundary of the Mid North Sea Natural Area.

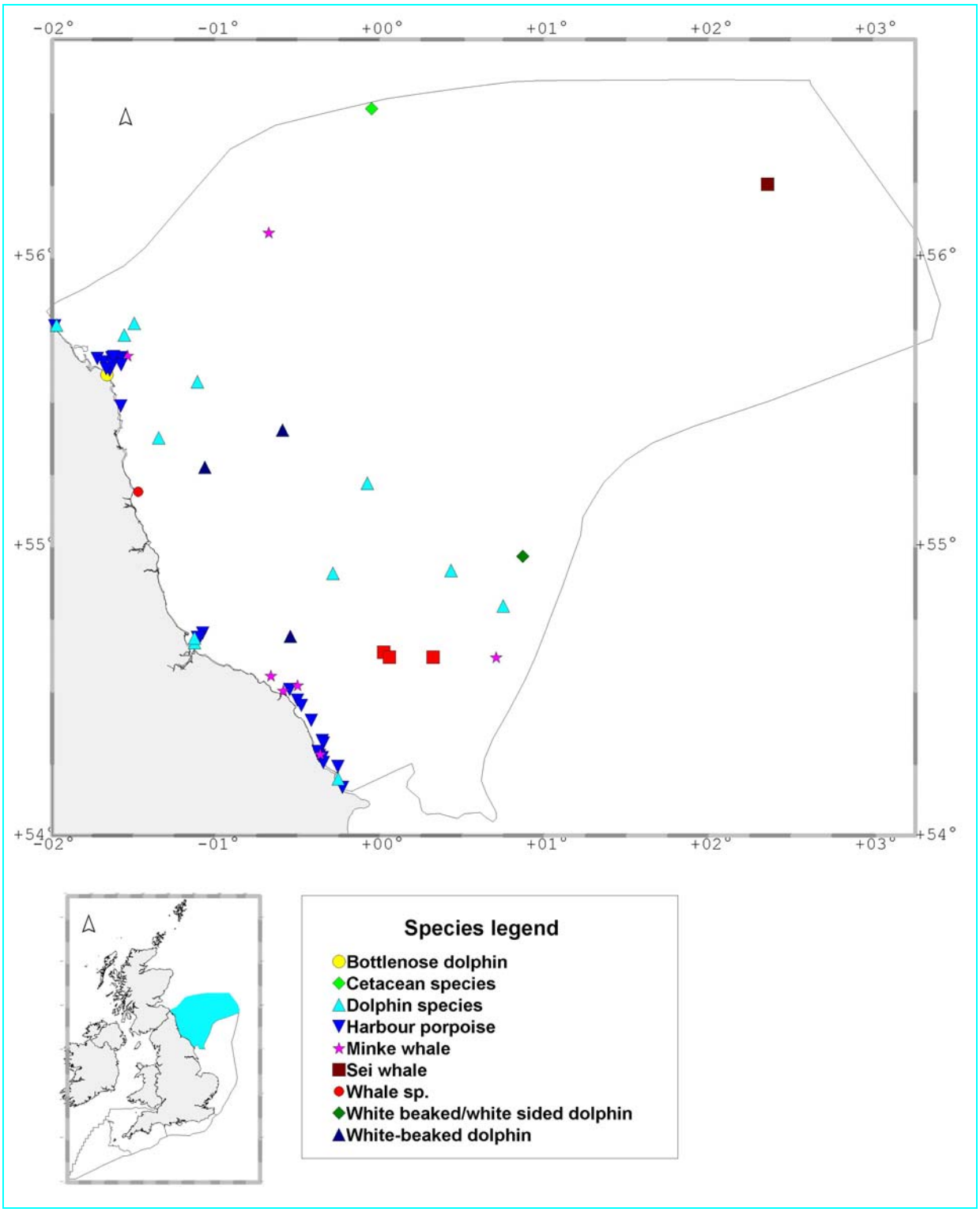
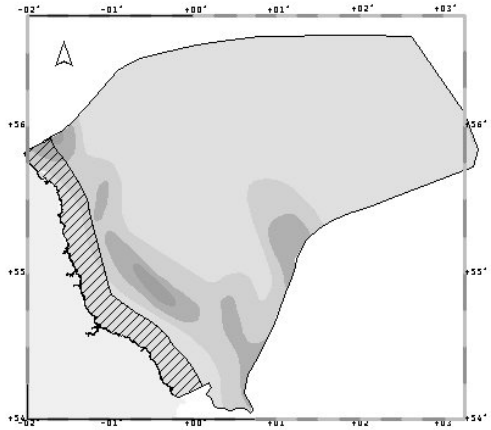


Figure 5.2 Records of cetaceans seen in the Mid North Sea Natural Area (after Evans *et al* 2003).

a) Distribution of mackerel spawning (May–Aug) and nursery areas within the Mid North Sea Natural Area

b) Distribution of herring spawning (autumn–winter) and nursery areas within the Mid North Sea Natural Area

c) Distribution of cod spawning (Feb–Apr) and nursery areas within the Mid North Sea Natural Area.



d) Distribution of plaice spawning (Dec–March) and nursery areas within the Mid North Sea Natural Area (dark grey = intensive spawning → light grey = low intensity spawning)

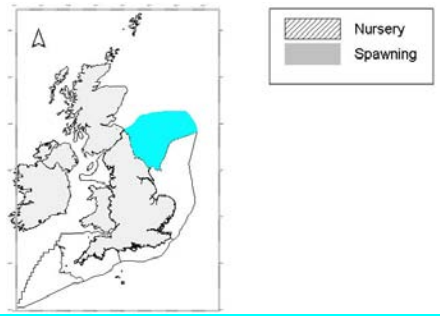


Figure 5.3 Maps showing the distribution of spawning and nursery areas within the Mid North Sea Natural Area. (Data taken from Coull *et al* 1998 and provided by CEFAS).

6 Human activity and use

This section outlines significant human activities in the Mid North Sea which are relevant to the nature conservation values described in the previous sections. This section does not provide a comprehensive listing of all the social and economic activities of the Mid North Sea, and for those that are included, the descriptions are brief. Rather, the intention is to give an overview of the range of activities which do or could interact with the environment. We have emphasised the need to consider these together if we are to achieve sustainable use of the marine environment and its biodiversity.

6.1 Fisheries

This area of the Mid North Sea forms an important focus for fishing activity. The region is an important area for populations of a number of commercial fish species, providing spawning grounds and nursery and feeding areas (see section 5.4). Consequently, it is an area of considerable importance for fishing activity. There are three major fishing ports (as defined by Defra) within this Natural Area - Scarborough, Whitby and North Shields – as well as numerous other smaller ports where fish are landed (see Figure 6.1). The largest landings (in tonnes) are from cod, haddock, whiting and lemon sole (Defra 2001).

The lobster (*Nephrops*) fishery in the northern part of this Natural Area has become increasingly important over the past few years. It is now the principle fishery of the trawl fleet in the Northumberland Sea Fisheries district. The fishery takes place between 3 and 25 miles offshore with the best catches landed during the autumn and winter months (D Bradbeer, pers comm.).

Fishing activity within this area has both direct and indirect effects on the environment. Although the most evident and direct impact of fishing is mortality and removal of fish from the marine ecosystem, other impacts are described in the following sections.

6.1.1 Physical impact of fishing gears

6.1.1.1 Towed or dragged gears

Trawling is the principal method of fishing for demersal species such as cod, plaice and sole. Examples of towed gears include beam trawls, dredges and otter trawls. These may be further considered in terms of mid-water and bottom trawl nets, depending on the depth of water and the species being caught.

Beam trawls - Beam trawlers are largely used to target flatfish such as sole and plaice that burrow in the sand, and pink and brown shrimps. The gear used by beam trawlers runs over the top of the seabed, often leaving behind a track or scour mark, depending on the type of ground being worked (Gubbay & Knapman 1999). In this type of trawl the mouth of the net is kept open by the beam that is mounted at each end on guides or skids that travel along the seabed. The trawls are adapted and made more effective by attaching tickler chains that drag along the seabed in front of the net, causing the fish to rise from the sand and into the oncoming trawl.

The extent to which the seabed is affected depends on the type of fishing gear, the substrata and its physical characteristics (Jennings & Kaiser 1998; Lindeboom & De Groot 1998). The tracks will gradually fill in, the time taken for this to happen depending on the type of ground, the depth of water (usually less then 50 metres), the strength of the tide and overall weather conditions. Other types of towed gear can also alter the substrata. The impact appears to be greatest on densities of small fragile benthic species, possibly because larger animals live deeper in the sediment or are better able to escape (Bergman & Hup 1992). Changes in benthic community structure occur following beam trawling but the effects can be variable (De Groot 1984; Jennings & Kaiser 1998; Lindeboom & De Groot 1998). In intensively trawled areas it has been suggested that the community becomes more dominated by highly productive, opportunistic species such as polychaetes. Beam trawling is practiced throughout this Natural Area but at low intensities.

Otter trawls - The otter trawl is a large cone-shaped net, which is towed across the seabed. The mouth of the net is kept open by otterboards. These are in contact with the seabed. They may mound the sediment as well as creating a scour furrow (Gilkinson *et al* 1998). This may alter the surface roughness of an area as well as the sediment structure. Otter trawling, like beam trawling, can result in the capture of a considerable amount of by-catch species, though certain selectivity measures (such as incorporating square mesh 'windows' in the top of trawl nets which allow the release of non-target species) are now more readily used. Trawls can sometimes be fitted with rock-hopper gear to enable them to traverse reefs. Otter trawling is mainly used to target species such as cod, plaice, sole and *Nephrops* and is practiced throughout the Natural Area at low intensities.

6.1.1.2 Static gear

Gill nets can be set at or below the surface, on the seabed, or at any depth inbetween. This type of gear can result in the incidental capture of marine life, most notably marine mammals and seabirds. They also have the potential to continue fishing if lost or discarded, an effect which has been described as 'ghost fishing' (Kaiser *et al* 1996) (see section 6.1.3). In this Natural Area gill nets or trammel nets are used mainly to catch cod during the autumn and winter months. Drift nets and 'T' nets are used to catch salmon and sea trout in the spring and summer. Pots or creels are also used to catch brown crab, lobster and velvet crab, and tangle nets are increasingly being used on the seabed. There is also a small amount of long-line fishing.

6.1.2 Stock depletion

One of the consequences of over-fishing is stock depletion to the point where there is a risk of stock collapse. The North Sea as a whole is one of the most productive fishing grounds in the world, with an annual harvest of approximately 2-3 million tonnes, equivalent to 3% of the world catch (Marine Conservation Society 2000). In the 1960s the North Sea herring fishery collapsed as a result of over-exploitation. This fishery was closed in 1977 and re-opened in 1981. The North Sea mackerel stock has still not recovered from over-fishing in the 1970s, and the fishery remains closed. More recently, record low levels in spawning stock have been recorded for North Sea plaice, haddock, sole, skate and cod. A long-term cod recovery plan is in the process of being developed for the North Sea.

6.1.3 Fishing debris

Fishing activity has been identified as one of the four major sources contributing to litter found on UK beaches (Marine Conservation Society 1999). Items such as fishing nets, fish boxes and buoys from the fishing industry account for 11.2% of the total amount of litter found. One of the consequences of fishing-related debris in the marine environment is 'ghost fishing'. This is where nets or pots, lost either because of bad weather, snagging, towed away by mobile fishing gears or simply discarded, remain either on the seabed or in the water column and continue to 'fish'. Often though, lost or discarded nets are rolled up on the seabed by the action of currents or wave action and cease fishing relatively quickly. However, floating debris may entangle marine life close to the surface, such as cetaceans, seabirds, seals and turtles.

6.1.4 By-catch

One of the problems associated with most types of fishing gear is that of incidental capture or by-catch of non-target species. This may include other commercial and non-commercial fish, seabirds and sea mammals. In particular, concern has grown over the by-catch of cetaceans in a number of different types of gear, including bottom-set gill nets and trawl nets. The impact of incidental capture on porpoise populations around the UK as a whole is not known. However, it has been suggested that incidental by-catch could be a significant contributory factor in the overall decline in abundance of harbour porpoise in European waters (Gislason 1994). The interaction between gill nets and harbour porpoises has been investigated in several areas particularly the Celtic Shelf, the North Sea and west of Scotland (Defra 2003).

Various methods and devices have been trialled to deter cetaceans from becoming entangled in nets, including the use of 'pingers'. These are acoustic deterrent devices (Reeves *et al* 2001) that can be run with a small battery pack for periods of months or years. Pingers have been shown to be effective in mitigating small cetacean by-catch in fixed gear, both in controlled experiments and in fishing operations. They have been recommended for use in large mesh nets and wreck nets in certain part of the North Sea (Defra 2003). However, they have only been tested on a few small cetacean species so far. The Government is developing a small cetacean by-catch response strategy that may include compulsory use of sonic devices and wider use of observers at sea.

Other mitigation measures include the use of 'escape hatches' in nets, making nets more 'reflective' (experiments have been tried by coating nets with a layer of iron oxide or barium impregnated nylon to make them stiffer (Larsen *et al* 2002)).

6.1.5 Ecosystem effects

The intense fishing activity in the North Sea has resulted in the 'fishing down' of the food web (Pauly and Maclean 2003). This is where the top predators have been removed, leading to modifications in predator-prey relationships and changes in marine food chains. The removal of the top predators has been linked to the growth of industrial fisheries (those fisheries targeting species for non-human consumption), in particular those focused on sand eels. However, these industrial fisheries are also of concern. As species near the base of the food chain are removed in vast quantities this may impact the breeding success of bird species that rely on them as a food source.

6.2 Oil and gas extraction

There are a number of oil fields and installations in this Natural Area, eg Auk, Fulmar and Janice (Figure 6.2). Further information on the locations of fields and installations can be viewed at http:///www.og.dti.gov.uk/information/index.htm. There are no commercial gas fields or installations in the Area as the main gas province lies to the south of the Mid North Sea Natural Area.

The UK Government has the right to grant licences to explore and exploit resources such as oil and gas. The UK Continental Shelf is divided into a series of blocks for which licences are granted. Of the 200 blocks within the Mid North Sea Natural Area, 22 were licensed in the 2001-2002 20th licensing round. Further details of the 21st round are available at http://www.og.dti.gov.uk/upstream/licensing/21_11_rnds/index.htm. Further information can also be obtained from the DTIs Strategic Environmental Assessment reports SEA2 and SEA3, which are available via the SEA website at http//www.offshore-sea.org.uk/sea/index.php.

Any activities for or in connection with the exploration for or production of petroleum which are situated wholly or partly in the UK Continental Shelf Designated Area are subject to the application of the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 which apply the Habitats and Birds Directive to the offshore waters in relation to oil and gas activity. In addition to provision for features covered by the Habitats and Birds Directives, all activities are required to submit a notification to the Consent Authority and an Appropriate Assessment may be required before consent is granted.

The major activities associated with oil and gas developments that have potential impacts on the marine and coastal environments can be summarised under the following categories.

6.2.1 Evaluation

During the initial surveys to locate reserves, seismic surveys are carried out using air guns, which can disturb fish and cetaceans. Underwater sounds from seismic activities are most likely to affect baleen whales, which communicate primarily at similar frequencies to those produced by air guns (Baines 1993). However, our understanding of cetacean communication and sensitivities is currently restricted due to data limitations. There are several characterisation and impact studies planned that will add substantially to our understanding of the issue in the near future.

Some seismic survey techniques have the potential to interfere with commercial fishing, with some species of fish being more resistant to these effects than others. Fish with cylindrical bodies and thick-walled swim bladders will be more resilient to the effects of air guns than fish with flat bodies and thin-walled swim bladders (Hailey 1995). Potential adverse effects of seismic surveys on fish are considered to be mitigated by seasonal exclusion zones. There is some evidence to show that the shoaling behaviour of some species is affected by seismic surveys, whilst others avoid areas in which surveys are being conducted.

Conditions on exploration and production licences, recommended by Fisheries Departments, prevented seismic surveys being carried out during specified periods of the year (during fish spawning) in specific areas (CEFAS 2001b) These have now been replaced by a survey permit system. Any activities for or in connection with the exploration for or production of

petroleum which are situated wholly or partly in the UK Continental Shelf Designated Area are subject to the application of the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001. In addition to this sesmic surveys should follow the JNCC's *Guidelines for minimising disturbance to marine mammals from seismic surveys* (www.jncc.gov.uk/marine/seismic_survey/default.htm#minimising)

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6.2.2 Exploration

One of the most significant impacts of the exploration stage is the effect of drill cuttings on marine wildlife (Hailey 1995). Two types of adverse effects of discharges of cuttings can be distinguished:

- physical smothering, which creates anoxic conditions and may eliminate all benthic fauna, and
- chronic pollution of the benthos as a result of the use of oil-based muds (though these are rarely used now).

It has been suggested that contaminated cuttings quickly disperse in the North Sea, causing little impact on the seabed around the drilling area and so decreasing the impacts from exploration.

6.2.3 Development and production

Seabed disturbance can occur as a result of the construction/placement of the platform and its subsequent presence and use. Drilling will result in larger and more heavily concentrated discharges of drilling fluids and cuttings. There is also a small risk of blow-outs as most of the reserves are so heavily extracted there is probably insufficient pressure to produce this. Accidental spillages can also result from refuelling of the rig and pipeline installation can disturb the seabed. See also section 3.7.3.1.

6.2.4 Abandonment and decommissioning

The process of decommissioning can also have detrimental affects on the benthos and the pelagic species in the water column. The main source of concern is the level of toxic substances that can be released. These substances may consist of hydrocarbons, heavy metals, naturally-occurring radioactive material and possibly organochlorines, such as polychlorinated biphenyls (PCBs) (Environment Agency 1998). Another concern is that the dismantling of platforms may disturb the piles of contaminated drill cuttings on the seabed, which could release substantial amounts of oil into the environment. However, decommissioning applications are considered on a case-by-case basis by the Department of Trade and Industry, in full consultation with JNCC, English Nature and other consultees.

6.3 Aggregate extraction

Sand and gravel on the seabed are important sources of industrial aggregate for concrete production, road construction, building and, increasingly, for beach replenishment and soft coastal defence. As pressures on land-based sand and gravel sources increases, there is a need to consider alternative sources of supply. Whilst secondary and recycled aggregates play an increasing role there is likely to be an increased demand for marine dredged sand and gravel. The main market for marine-dredged aggregates is in the south east of England.

The Crown Estate license extraction within their areas of jurisdiction. However, Government controls the dredging of marine aggregates and this has historically been exercised through the Government View Procedure, currently administered by the Minerals and Waste Planning Division of the Office of the Deputy Prime Minister. It is anticipated that new Regulations will come into force in the near future. These new Statutory Regulations will apply to England, Wales and Northern Ireland. Scotland will introduce their own regulations to govern extraction of marine minerals.

Applications for the extraction of marine minerals are currently operating under the Interim Government View Procedures, pending introduction of the Statutory Procedures. Both the Interim and anticipated Statutory Procedures are to be administered by Office of the Deputy Prime Minister in England, DoE(NI) in Northern Ireland, the Welsh Assembly Government and the Scottish Executive, as appropriate. Each application will require an Environmental Impact Assessment and extensive consultation with the fishing industry, relevant government bodies and the general public. Both the Interim and anticipated Statutory Procedures have provision to hold a public inquiry if necessary.

Although marine dredged aggregate is landed in the wharves of two ports within this Natural Area (Tyne and Tees), there are no areas within the Natural Area where aggregate extraction takes place. There are gravel deposits along the coast between Blyth in Northumberland and Sunderland in Tyne and Wear, but this area has been affected by many years of colliery waste dumping, which has made the aggregates there unsuitable for use in concrete production (Crumpton & Goodwin 1995).

The physical impacts of marine aggregate extraction arise from removing the substrata and altering the seabed topography; creation of a turbidity plume within the water column in the area of activity, and sediment redeposition. Dredging disturbs the benthic community and can reduce the number and diversity of benthic species (Rosenberg 1977). One fish species considered to be potentially at risk as a result of marine aggregate extraction within the Natural Area is the herring *Clupea harengus,* which lays eggs that adhere to gravel (ICES 1992).

Sediment plumes arising from dredging introduce sediment into the water column in the vicinity of the dredged area. John *et al* (2000) identified reduced light penetration as a result of turbidity as one of the main water quality issues arising from increased suspended sediments in the water column. High levels of suspended sediments, along with the associated reduced light penetration, can adversely affect primary production within the water column (Iannuzzi *et al* 1996).

Redeposition of the particles from these sediment plumes will also occur and, once settled on the seabed, will be liable to resuspension or transport over the substrata. A consequence of this is the smothering of benthic species, which may suffocate many suspension-feeding invertebrates. This may also smother fish eggs on spawning grounds.

6.4 Shipping

6.4.1 Commercial

Many different types of vessel operate in this area, according to the nature of the cargo they are carrying (see Figure 6.3 and Table 6.1).

Since the mid-nineteenth century the volume of goods transported by sea has grown enormously. The growth of the petroleum industry had a very significant effect on shipping with the advent of the oil tanker, which is the largest carrier of cargo. The carriage of goods by sea inevitably places marine and coastal environments at some risk. Almost any vessel anywhere has the potential to cause a degree of environmental damage, either through routine operations or accidents. Despite this, shipping is responsible for a relatively small proportion of all marine pollution in the UK, compared to that from land-based sources. Much of the marine pollution be traced back to centres of population and to industrial and agricultural operations.

There are four potential areas of concern with commerical shipping:

- **Historical pollution** - for example, the application of TBT has now been banned on vessels of all sizes by the International Maritime Organisation, with a global ban due to come into force in 2008.
- **Operational pollution** – these consists of oil and oily wastes, noxious liquid substances, sewage, garbage.
- **Accidental pollution** – as a result of collision or grounding, which can result in large quantities of pollutant being released into the marine environment. The types of pollutants are similar to those associated with operational discharge.
- **Physical damage** – resulting from the grounding of vessels, anchors dragging along the seabed and disturbance from propellers.

The extent of environmental damage following any accident depends on a range of factors, in particular the cargo of the vessel, where the accident occurs, the depth of water, the state of the tides and at what time of year. Within this Natural Area the predominant types of shipping vessels are cargo carriers (see Figure 6.3 and Table 6.1).

Within recent years a number of shipping incidents involving the release of oil has occurred within and around the boundary of this Natural Area (see Figure 6.4). From the 10 oil spills which occurred in and around the Mid North Sea Natural Area during 1989-1998, a total of 34.79 tonnes of oil were released into the environment (Safetec 2000).

Attention tends to focus on accidents involving large oil tankers, although smaller vessels carrying other cargoes and large quantities of fuel, together with illegal ship discharges, can also threaten marine environments. Seabirds are most vulnerable to oil spills as many species congregate at high densities to feed, nest and moult. In such situations, a large proportion of the total population is susceptible to local incidents, such as oil spillages (RSPB 2000). Species such as divers and grebes found within this Natural Area moult their feathers simultaneously, becoming temporarily flightless (Tasker *et al* 1990). This makes them particularly vulnerable to oil spills at this time. In addition, the majority of marine birds are

long-lived, do not reach breeding condition for many years and have low reproductive rates. As a result, even highly localised incidents can have a significant impact upon a population.

In an attempt to address some of the problems caused by shipping, the Donaldson Inquiry was initiated to 'identify what can reasonably be done to protect the UK coastline from pollution from merchant shipping' (Donaldson 1994). The Inquiry, initiated after the *Braer* disaster, provided an overview of the use of routeing measures aimed at accident prevention and subsequently dangers of pollution and loss of life. Routeing measures ensure that ships are kept outside areas where pollution would cause particular damage to the environment. One of the major recommendations of the inquiry was the establishment of Marine Environmental High Risk Areas (MEHRAs). These are comparatively limited areas of high environmental sensitivity that are at risk from shipping. The idea was that identifying MEHRAs would give ship masters additional information relevant to passage planning, which would result in the usage of the recommended routeing and reduce pollution risk at these sites.

The process of identifying MEHRAs is well advanced, though the timescale for their introduction has not been decided.

Table 6.1 Annual total of number of vessels passing through the Mid North Sea Marine Natural Area in 1999. (Data taken from COAST database).

Vessel type	Annual total for Mid North Sea Marine Natural Area
Bulk	1,112
Cargo	12,412
Ferry	1,216
Gas carrier	3,428
Roll-on, Roll-off	4,504
Standby	50
Supply	110
Chemical tanker	3,128
Oil tanker	5,852
Shuttle tanker	384

6.4.2 Ferries

A small proportion of the marine traffic within this Natural Area is composed of ferries that transport cars and passengers across the North Sea.

On average, approximately 20 ferries pass through this Natural Area per week (see Figure 6.5). Passenger and/or car ferries pose very little threat to the marine environment when compared with tankers or cargo vessels, as they tend not to carry hazardous chemicals. However, grounding incidents can have an impact on the marine environment and may result in large areas of the seabed being damaged. In shallow water, propellers can also cause disturbance. Information taken from Lloyd's Register Casualty Database (Safetec 2000) shows that during the period 1989-1998, only 3% of grounding incidents for the whole of the UK involved ferries.

6.5 Waste disposal

The disposal of waste or other matter into the sea is prohibited by the OSPAR Convention, with the exception of dredge material, waste from fish processing, inert material of natural origin and, until 2004, vessels and aircraft (OSPAR Commission 2000). In the past a range of material including sewage sludge and industrial waste had been disposed of at sea, although industrial waste disposal was phased out in 1992. The disposal of sewage sludge has been banned under the OSPAR Convention since 1 January 1999. The largest sites (historically) for the disposal of sewage sludge within the Natural Area were off the mouth of the Tees and the mouth of the Tyne (see Figure 6.6). During the period 1993-1998 there was no sludge disposal off the Tees Estuary. This ceased altogether in January 1999. However, data is being collected by CEFAS, under the auspices of the National Marine Monitoring Programme, from a number of the former disposal sites. This will hopefully provide some insight into the long-term impact of sewage disposal.

As indicated earlier in this section, the disposal of dredged material is still permitted at a number of sites within this Natural Area (see Figure 6.6). Disposal of dredged material in UK territorial waters is controlled under the Food and Environment Protection Act 1985 (FEPA), which requires a licence for depositing substances or articles onto the seabed. Dredged material consists primarily of material removed to keep navigation channels clear (maintenance dredging), or material removed in the course of coastal construction engineering projects, including the digging of new navigation channels (capital dredging). The sediments dredged from some of the UK's ports and harbours may be contaminated with heavy metals, nutrients, organic pollutants and other substances. However, stringent sediment quality guidelines are applied during the consents procedure to prevent heavily contaminated material being disposed of out to sea.

Open water disposal of uncontaminated dredged material, if properly handled, appears to cause few problems in the long term (GESAMP 1990). The short-term and localised effects of disposing dredged material at sea are summarised by Posford Duvivier Environment (1992) as:

- Increased turbidity in the dumping area, reducing light penetration and affecting filter-feeding organisms.
- Smothering benthos with the result of destroying the communities present.
- Potential change in sediment size distribution that may affect spawning and recolonisation.
- Water quality deterioration if the sediment is contaminated.
- Changes in bathymetry of the seabed that may affect benthic and demersal communities.

Defra's policy on disposal aims to minimise the disposal of clean dredged materials, especially sands and gravels, in favour of identifying beneficial uses such as beach nourishment, saltmarsh restoration or mudflat enhancement. This also helps to reduce the loss of material from coastal cells. The Marine Consents and Environment Unit within Defra tries, wherever possible, to work with licence applicants, nature conservation bodies, coast protection authorities, the Environment Agency and others, to identify potential schemes that use dredged material in a practical and appropriate manner.

6.6 Litter

Despite laws and regulations, litter is still a considerable problem for the marine environment and coastal communities (OSPAR 2000). Potential sources of litter are mainly related to waste generated by shipping and tourist/recreational activities. Litter may also be transported into the sea by winds, currents and rivers. Fishing debris such as nets and buoys also contribute to the litter found within this Natural Area. One of the consequences of fishing-related debris in the marine environment is ghost fishing, whereby the discarded gear continues to 'fish' (see section 6.1.3). Floating debris may also entangle marine life close to the surface, such as seals, cetaceans, turtles and seabirds. In 1991, the North Sea (along with the Baltic Sea), were designated as MARPOL Special Areas (Annex V), where the disposal of garbage and litter from ships is prohibited.

At a recent OSPAR commission ministerial meeting, the contracting parties agreed to "do their utmost to take measures to eliminate the problem of litter" including through OSPAR's Marine Litter Monitoring Work Programme (OSPAR 2003).

6.7 Submarine cables

A number of submarine communication cables traverse the Mid North Sea Natural Area (see Figure 6.7). Submarine cables have been laid on the seabed since before 1900. Cables installed since 1983 are buried beneath the seabed wherever possible to a depth of 40-90 centimetres, although they can often be scoured out by tide and current or can be dragged out by anchors and fishing gear. Even though attempts are made to bury new cables they can still interfere with fishing operations or cause damage if they become snagged in fishing gear. The environmental effects of cable laying, however, are limited (Department of the Environment 1993).

6.8 Wind farms

As part of its strategy to reduce emissions of greenhouse gases (notably carbon dioxide) from burning fossil fuels, the Government has set a target to generate 10% of the UK's electricity from renewable sources of energy by 2010 and 5% by 2003 (English Nature *et al* 2001). Wind energy is the fastest growing energy technology in the world and Government recognises that offshore wind farms can contribute considerably to those targets.

Currently one small development exists within this MNA. Located 1 kilometre off the coast of Blyth Harbour, Northumberland (see Figure 6.8), the two 2 Megawatt turbines were commissioned in December 2000. Although it was suggested that this small development should produce enough energy for 3,000 homes, its main function is to test wind energy technology. At the time of construction, the turbines were the largest erected offshore in the world. They were also the first to be placed in such a demanding position, subject to the full forces of the North Sea.

In April 2001, following a pre-qualification process, companies were given an agreement of lease by the Crown Estate to pursue 15 developments in the first full round of offshore wind farms in the UK. One windfarm development was proposed within this MNA from this first round for which an application is imminently expected. In July 2003, a second round of offshore wind developments was announced. In this round, leases have only been offered

within three 'Strategic Areas' of the UK which have undergone a Strategic Environmental Assessment process. Part of the marine environment within this MNA lies within the Greater Wash Strategic Area. One of the eleven further locations leased for windfarm development under 'Round 2' (including four areas beyond 12nm) within this Strategic Area lies within the Mid North Sea MNA. If this proposal progresses to seeking development consent, it is unlikely that an application will be submitted before 2005. Further information can be obtained from **http://www.og.dti.gov.uk/offshore-wind-sea/process/envreport.htm**.

Factors that have influenced the initial location of proposed sites include the available wind resources, connection to the national grid, depth and substrata (as many sites coincide with shallow sandbanks). Other interests which may have been taken into account include other human activities and environmental interests. Each of these will be addressed in the Environmental Impact Assessments that accompany applications for relevant sites.

Windfarms may have a number of potential impacts on the environment, including on birds (eg risk of collision, exclusion from feeding areas), on mobile species from noise and vibration, on sediment transport and coastal processes, and on marine and coastal habitats and benthos. There is presently much discussion regarding the limitation of current data on many of these issues. Indeed, these issues form core concerns with respect to mitigation measures. However, the lack of extensive data severely restricts the effectiveness of the mitigation options available. To investigate some of these issues, a group was established in 2002 to co-ordinate research into impacts of offshore wind energy development on the environment. Chaired by the Crown Estate, the Collaborative Offshore Wind Research Into the Environment consists of members representing industry, NGOs and statutory nature conservation bodies including English Nature. The Group operates a research fund from the interest accrued from seabed leases granted as a result of the 'Round 1' consultation phase. Projects underway include the effects of electromagnetic fields; the effects of underwater noise and vibration; comparison of aerial and boat-based surveys for bird distribution and population studies; and investigation into potential displacement from feeding grounds of common scoter. Further information can be obtained from the Crown Estate website: **http://www.crownestate.co.uk/estates/marine/index.shtml**.

6.9 Recreational uses

This chapter has mainly considered the most important human activities within the Natural Area. There is, however, a range of recreational activities that occur within the Marine Natural Area which have a significant input into the local economy and are of interest to those engaged in coastal planning and management, as well as the users themselves. However, as most of these activities are confined to the coastal and inshore waters, we have not dealt with them in any great detail here. Further information can be found in the other publications such as the JNCC's Coastal Directories (eg Barne *et al* 1995) and English Nature's 'Regulation 33 Packages' (eg English Nature 2000).

Within the past 30 years there have been many infrastructure developments along the coast of this Natural Area, including marinas, yacht moorings, dinghy parks and launching slips. These developments have often been concentrated in or near large conurbations, where new and proposed water sports centres are sometimes a part of schemes to regenerate waterfronts. Limited facilities, primarily recreational craft moorings, are also found in most of the small harbours along the coast, and there are facilities for watersports around the main estuaries (Dunbar & Fowler 1995).

Boat trips (typically from Seahouses) are available to the Farne Islands to watch seals and seabirds. The islands themselves receive some 40,000 visitors a year, with many more participating in 'round the islands' trips. As a major threat to the seal colony here is from noise and visual disturbance, boat operators are instructed to avoid taking their boats too close to haul-out sites. The Farnes also provide the most important scuba diving destination within the Natural Area, with up to 100 rigid inflatable boats bringing parties of 4-6 divers to the Islands over a summer weekend. Diving and boat trips also take place along much of the North Yorkshire coast, particularly off Whitby, Scarborough and Filey.

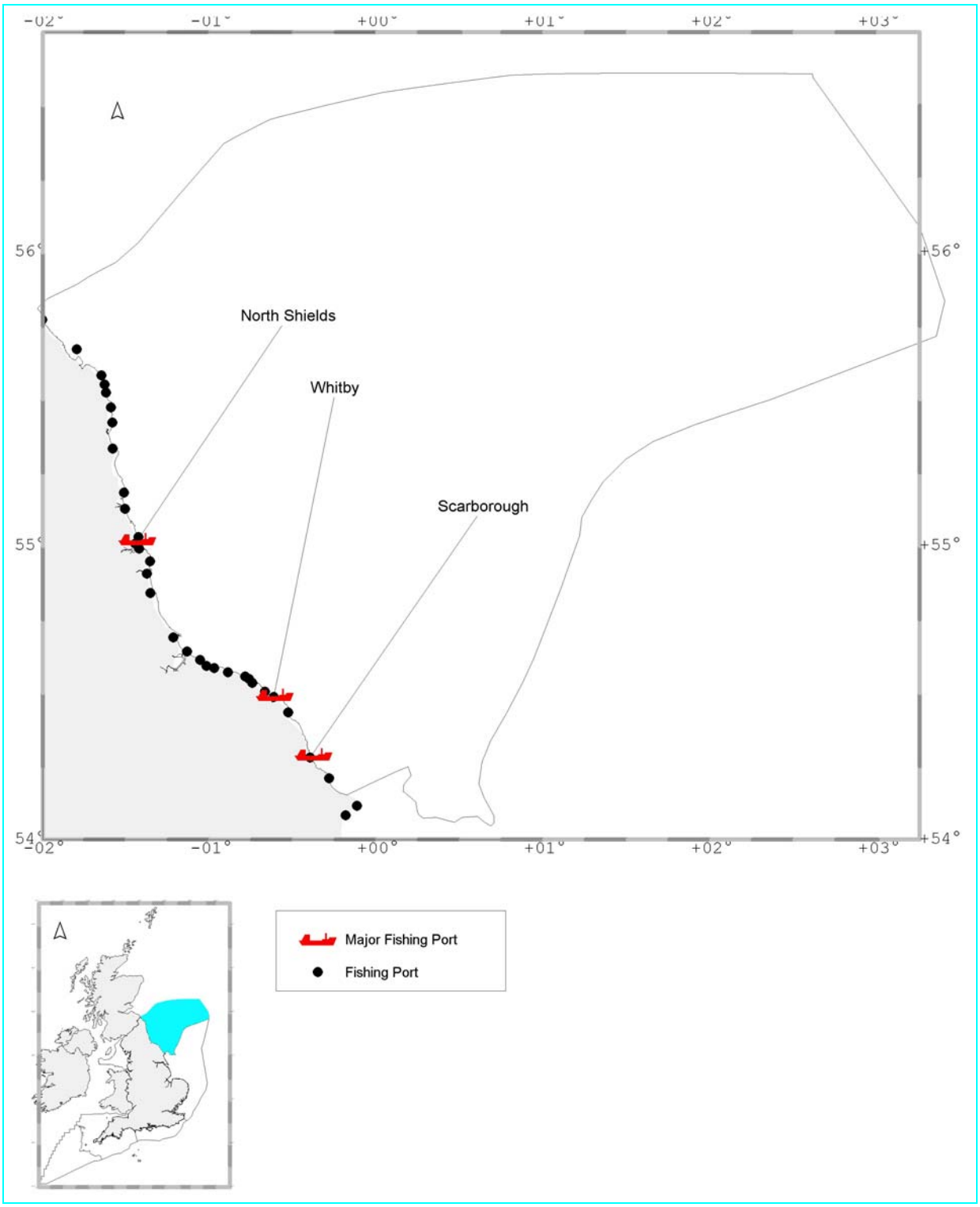

Figure 6.1 Distribution of fishing ports in the Mid North Sea Natural Area (data provided by CEFAS).

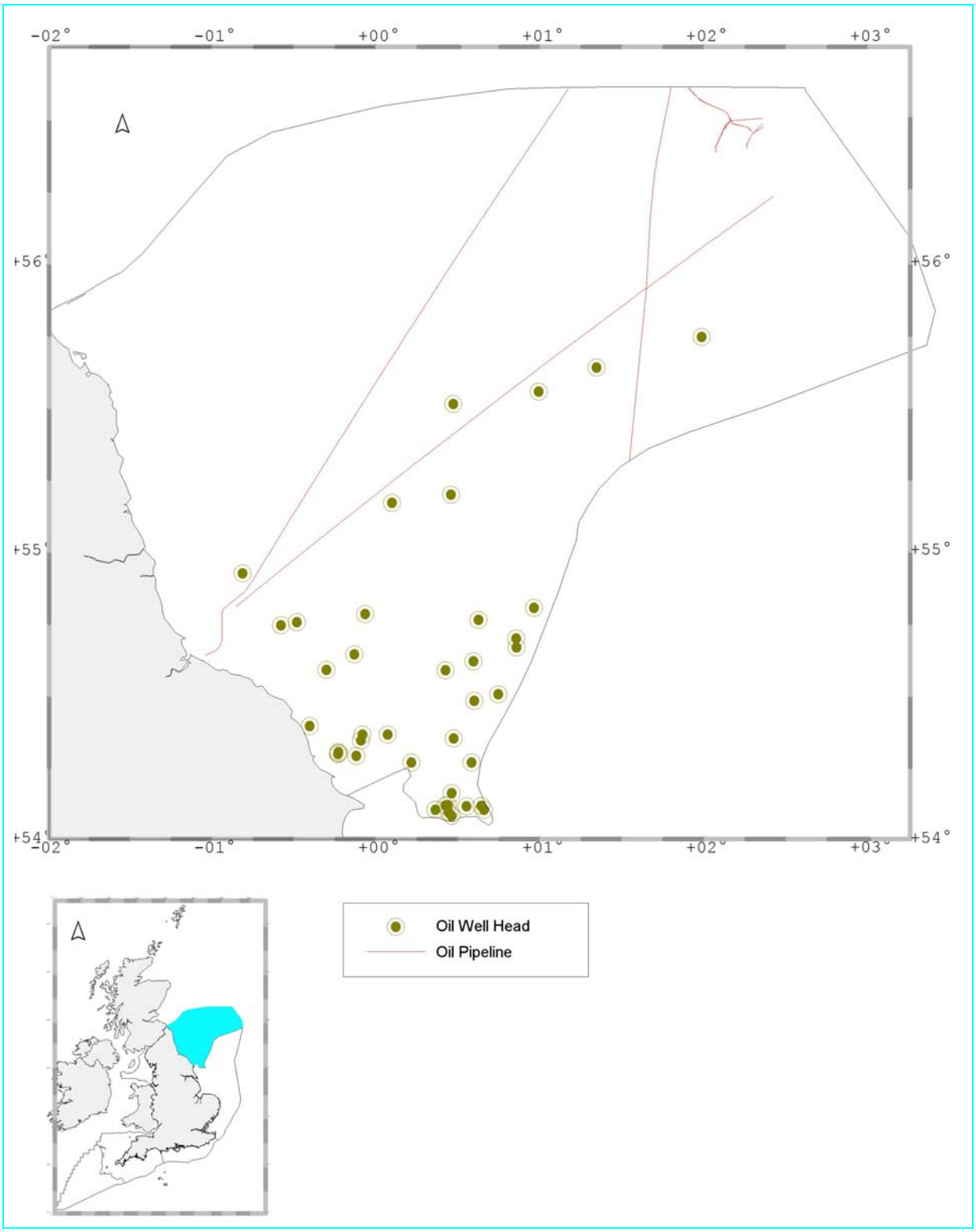

Figure 6.2 Oil well heads in the Mid North Sea. **NB**. Some of these have now ceased production. Both pipelines shown are for oil.

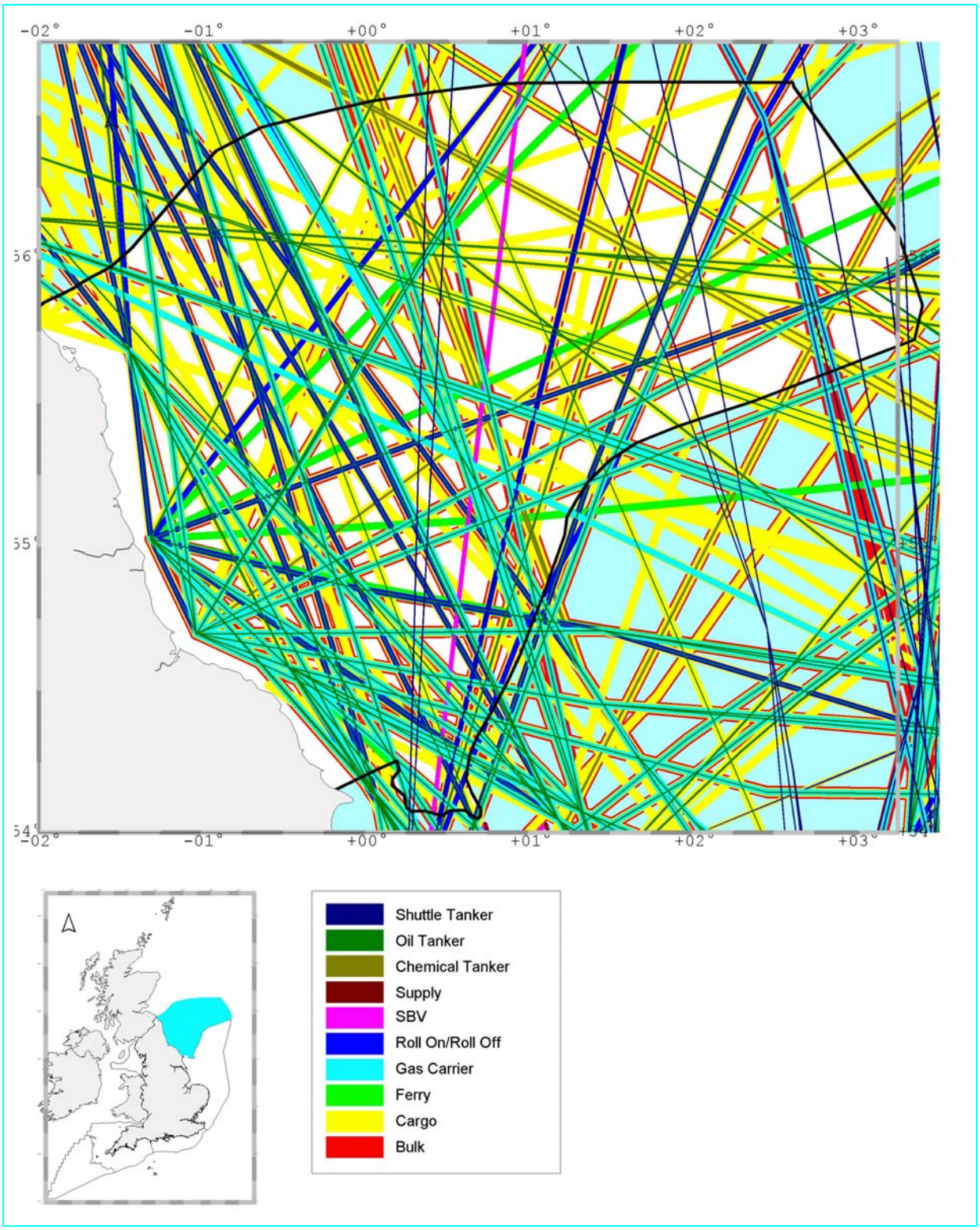

Figure 6.3 Map showing the various types of vessel and operating routes within the waters surrounding the Mid North Sea Natural Area during 1999. (Data taken from COAST database) (SBV = Standby vessel).

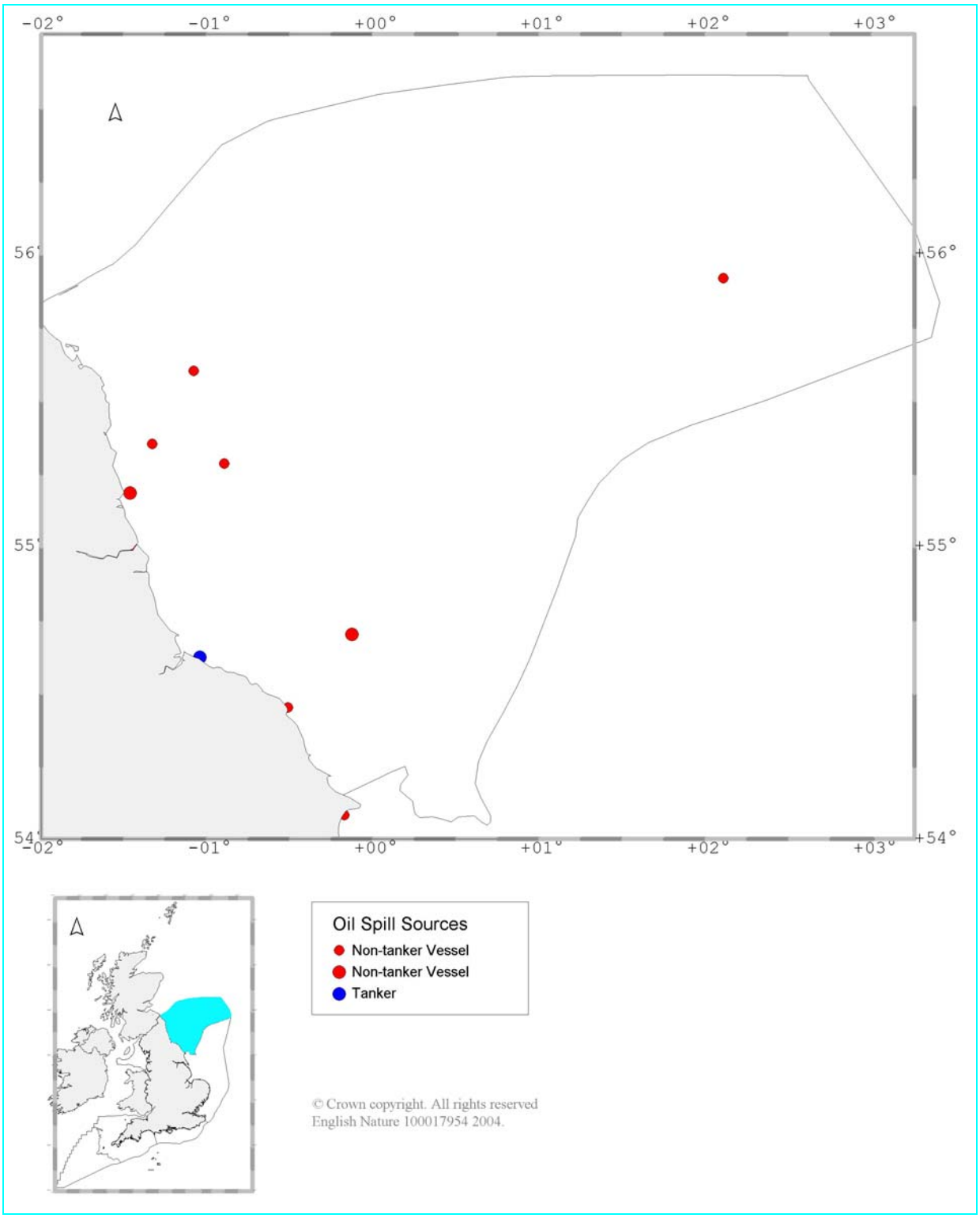

Figure 6.4 The distribution and severity of oil spills in the Mid North Sea Natural Area in the period 1989–1998. (ACOPS data from COAST database).

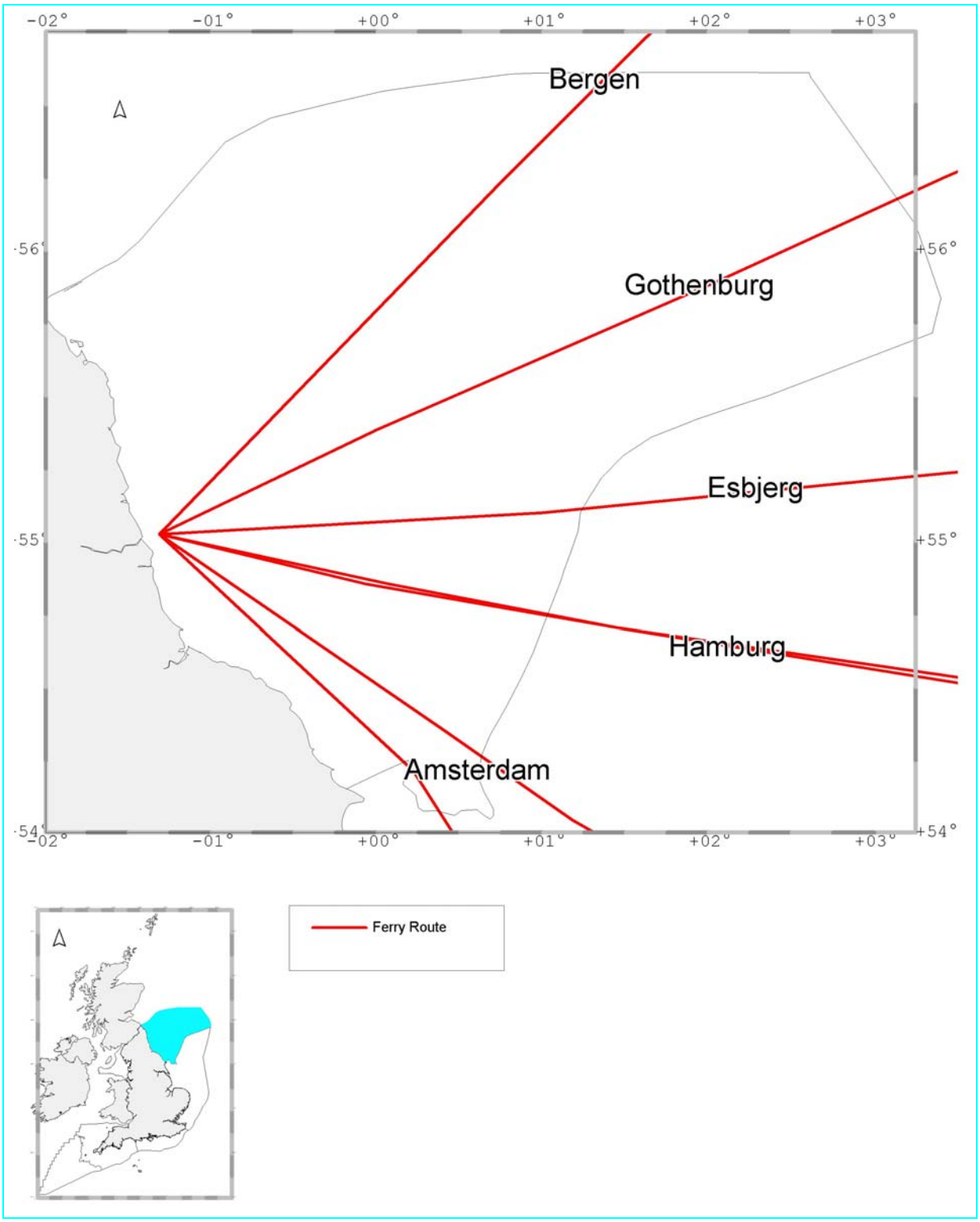

Figure 6.5 Map of ferry routes crossing the Mid North Sea Natural Area.

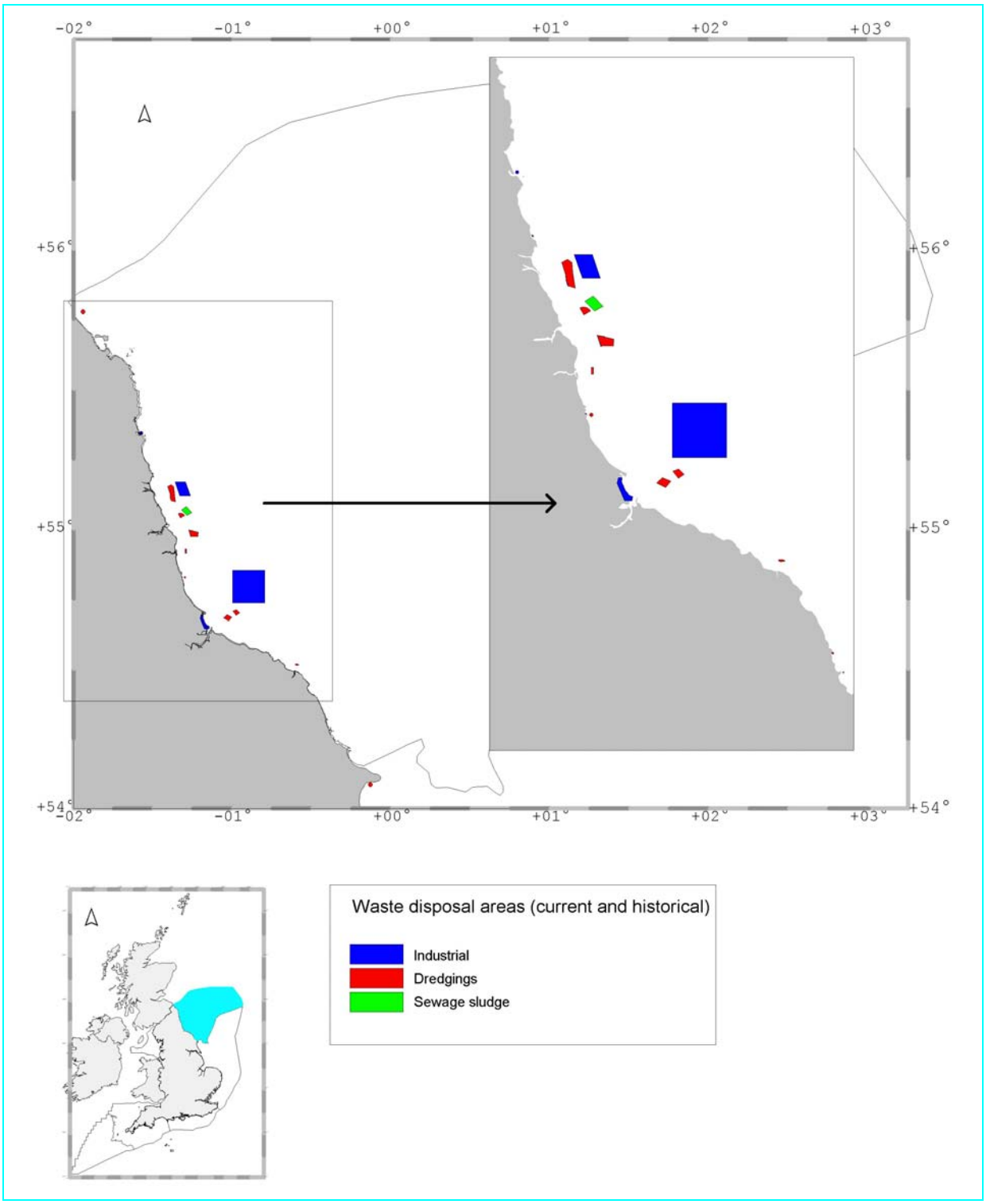

Figure 6.6 Distribution of disposal sites in the Mid North Sea Natural Area (data provided by CEFAS).

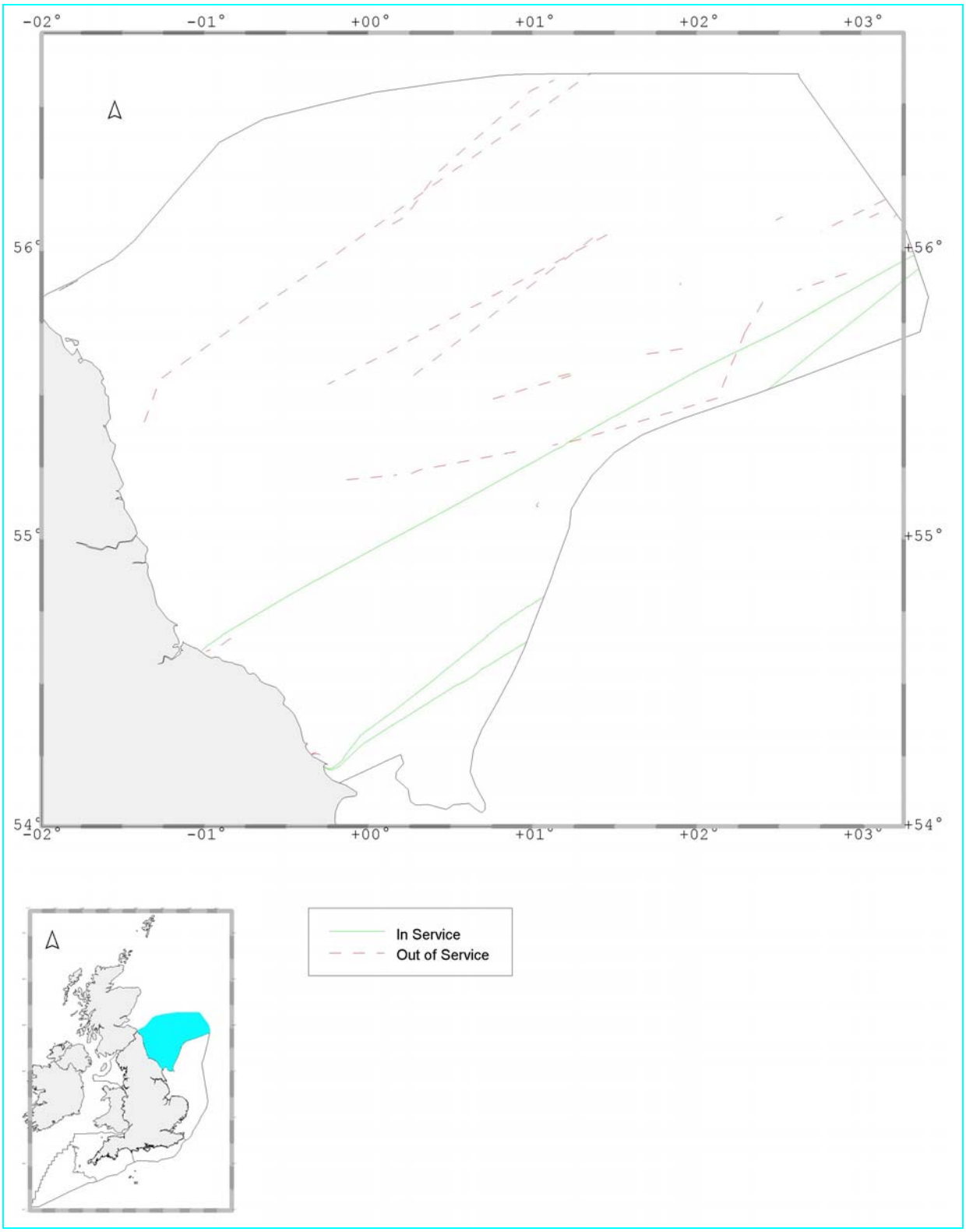

Figure 6.7 Map of submarine cables passing through the Mid North Sea Natural Area (data provided by Global Marine Systems).

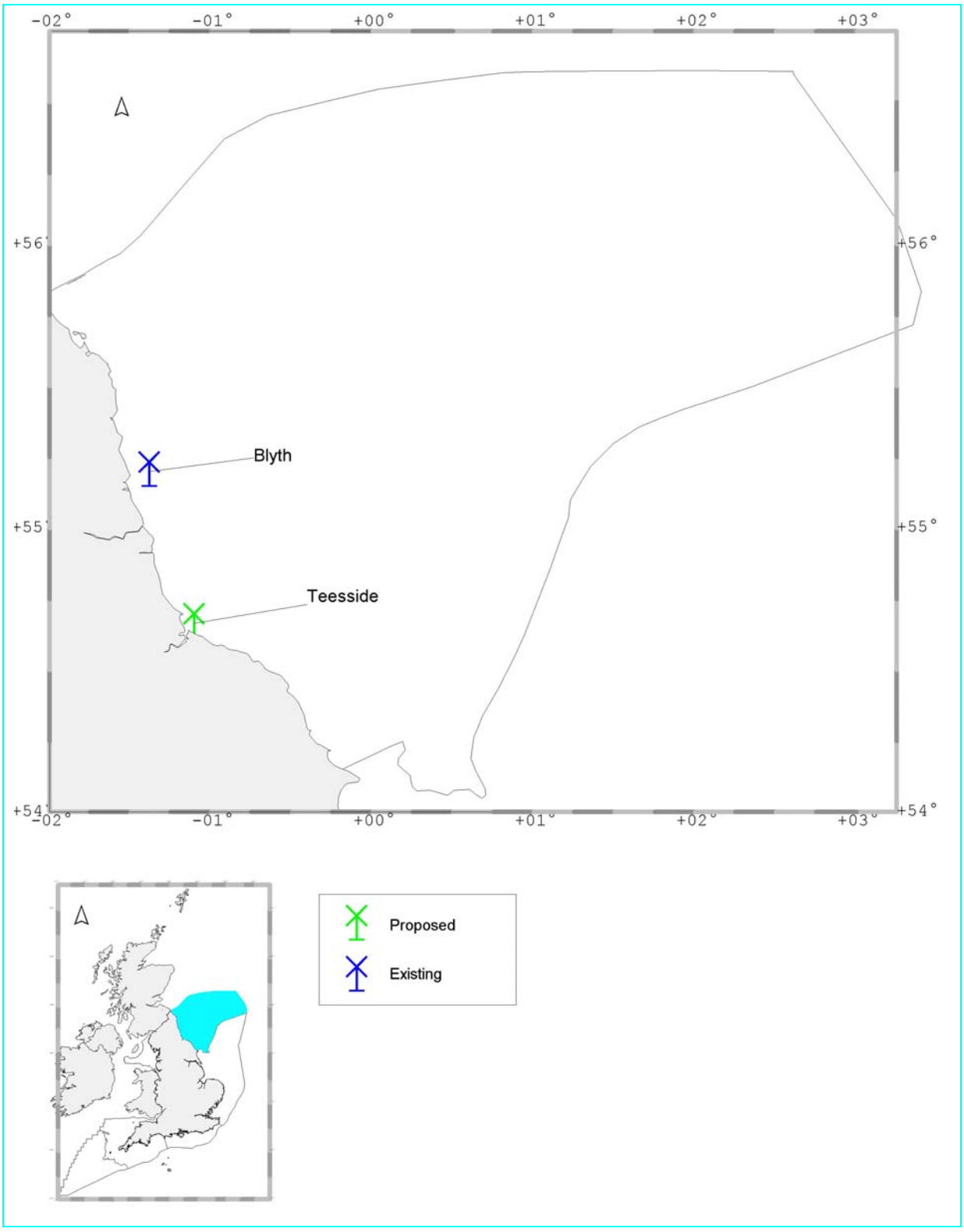

Figure 6.8 The distribution of existing and proposed wind farms in the Mid North Sea Natural Area (data provided by Crown Estates).

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Appendix 1 Marine Natural Areas and the ecosystem approach

An ecosystem consists of a community of plants, animals and micro-organisms and their physical environment. They are inter-dependent and may be best described as a network or web. In 2000 the Conference of the Parties to the Convention on Biological Diversity (CBD 2000) stated, amongst other things, that:

"The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Thus, the application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources."

"An ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems."

The following table provides a brief outline of the relevance of Marine Natural Areas to taking forward the ecosystem approach.

12 principles recommended by the Conference of Parties of the Convention on Biological Diversity in 2000 to guide signatory countries in the practical application of the ecosystem approach	**Relevance of Marine Natural Areas**
The objectives of management of land, water and living resources are a matter of societal choice.	English Nature believes that all key stakeholders should be involved in the management of the marine environment. The degree to which the ideas and information presented in these Marine Natural Area profiles are taken forward should be decided through dialogue amongst those stakeholders.
Management should be decentralised to the lowest appropriate level.	The better management of many marine activities around England, such as fisheries, aggregates and energy generation, requires a regional rather than simply a national approach. We feel that the Marine Natural Areas framework is at a scale that is appropriate for managing and governing the seas around England.
The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.	Marine Natural Areas are a broad scale, ecologically meaningful framework. Although some boundaries of individual Marine Natural Areas may need further refinement, we feel that this initial framework provides a good basis for testing and applying the ecosystem approach at an appropriate, ie regional, scale.
Recognising the varying temporal scales and lag-effects that characterise ecosystem process, objectives for ecosystem management should be set for the long-term.	Marine Natural Areas reflect broad scale factors and processes, some of which change only in the long-term, eg current patterns. Consequently objectives to guide management of human activities in Marine Natural Areas should consider a long-term as well as short-term perspective.

12 principles recommended by the Conference of Parties of the Convention on Biological Diversity in 2000 to guide signatory countries in the practical application of the ecosystem approach	Relevance of Marine Natural Areas
Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.	The emphasis on the key processes that help to define the Marine Natural Areas highlights the need to consider the interconnections both within the sea and also between Natural Areas. Consequently there is a need for a more integrated, holistic view of the effects of individual activities, including the cumulative effects over broad areas and adjacent waters.
Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: reduce those market distortions that adversely affect biological diversity; align incentives to promote biodiversity conservation and sustainable use; and internalise costs and benefits in the given ecosystem to the extent feasible.	Although Marine Natural Areas focus on defining ecological units and describing their biodiversity and nature conservation values, the descriptions also recognise key economic activities. Marine Natural Areas provide an ecologically relevant framework for management, including sustainable use, and offer a potentially common framework for aligning economic with environmental concerns. We appreciate the challenges this brings. We also recognise that the basis of 'regional seas' is likely to evolve and boundaries may be refined as interest in a potential regional approach to the marine environment gathers momentum.
Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.	Marine Natural Areas are based on both functional processes and structure and the link between them. Both should be reflected in conservation objectives for Marine Natural Areas.
Ecosystems must be managed within the limits of their functioning.	We must manage human use of the coasts and seas so that they do not damage the way the ecosystem works. For example, we should seek to ensure that particular activities do not affect the productivity of the marine environment. The development and application of conservation objectives for Marine Natural Areas will help towards identifying such limits.
Management must recognise that change is inevitable.	The marine environment is dynamic and responds to both man-made and natural changes. The profiles do not describe changes that have occurred within each Marine Natural Area in detail but change is implicit in an approach which emphasises functional processes and the link between these and structure.The development of conservation objectives and management for Marine Natural Areas should reflect the fact that change is often inevitable.
The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.	Marine Natural Areas provide an ecologically relevant framework at a scale appropriate for managing the use of biological diversity (such as fisheries) in a way that maintains wildlife. This will be addressed further through the development of conservation objectives and management for Marine Natural Areas, in conjunction with key stakeholders and government.
The ecosystem approach should consider all forms of relevant information including scientific and indigenous and local knowledge, innovations and practices.	The definition and description of Marine Natural Areas has drawn on a wide range of information but this has been largely technical in nature. Other relevant information is likely to be drawn on in the process of developing management for regional seas in partnership with other stakeholders, building on Marine Natural Areas as appropriate.

12 principles recommended by the Conference of Parties of the Convention on Biological Diversity in 2000 to guide signatory countries in the practical application of the ecosystem approach	Relevance of Marine Natural Areas
The ecosystem approach should involve all relevant sectors of society and scientific disciplines	A number of organisations have been consulted in defining and describing Marine Natural Areas including relevant regulatory authorities, industry, agencies and scientific institutes. However, this has been limited to those with relevant technical information. It is hoped that Marine Natural Areas will help to inform and structure a wider debate involving all relevant stakeholders in developing management for regional seas.

Appendix 2 Biodiversity Action Plan and Habitats Directive Classifications

Broad habitat types	Priority habitats
Inshore sublittoral rock	Sublittoral chalk *Sabellaria spinulosa* reef *Modiolus modiolus* beds
Inshore sublittoral sediment	Seagrass beds (*Zostera marina*) *Maerl* beds Mud in deep water Sublittoral sands and gravels
Offshore shelf sediment	Sublittoral sands and gravels

After Volume 5 of the *UK Biodiversity Group Tranche 2 Action Plans*

EC Habitats Directive – Annex I Habitats (relevant to Marine Natural Areas)

Physiographic features	Habitats
Large shallow inlets and bays	Sandbanks which are slightly covered by sea water all the time
	Mudflats and sandflats not covered by seawater at low tide
	Reefs
	Submerged or partially submerged seacaves

Appendix 3 Wentworth and Folk sediment classifications

<table>
<tr><th colspan="4">SEDIMENT SIZE</th></tr>
<tr><td rowspan="2">phi value</td><td rowspan="2">milli-metres</td><td colspan="2">SIZE CLASS</td></tr>
<tr><td colspan="2">WENTWORTH</td><td>FOLK</td></tr>
<tr><td rowspan="12">-8
-6
-2
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
8</td><td rowspan="12">256
64
4
2
1.41
1
0.71
05
0.35
0.25
0.17
0.125
0.088
0.0625
0.0039</td><td colspan="2">Boulder</td><td rowspan="4">Gravel</td></tr>
<tr><td colspan="2">Cobble</td></tr>
<tr><td colspan="2">Pebble</td></tr>
<tr><td colspan="2">Granule</td></tr>
<tr><td>Very Coarse</td><td rowspan="5">Sand</td><td rowspan="5">Sand</td></tr>
<tr><td>Coarse</td></tr>
<tr><td>Medium</td></tr>
<tr><td>Fine</td></tr>
<tr><td>Very fine</td></tr>
<tr><td colspan="2">Silt</td><td rowspan="2">Mud</td></tr>
<tr><td colspan="2">Clay</td></tr>
</table>

Appendix 4 Glossary and abbreviations

Definitions based largely on:
Covey & Laffoley (2002), Ellis *et al* (1996) and Hiscock (1996).

Anadromous (of fish)
Upward-running: spending part of their life in the sea and migrating up rivers in order to breed (eg salmon) (cf. "catadromous").

Bathymetry
Measurement of ocean or lake depth and the study of floor topography (Lincoln & Boxhall 1987).

Benthos
Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by tides as the littoral zone.

Bioaccumulation
The accumulation of a harmful substance such as a radioactive element, a heavy metal, or an organochlorine in a biological organism, especially one that forms part of the food chain.

Biodiversity (biological diversity)
"The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." (UN Convention on Biological Diversity 1992).

Biogeographic region
A region which is separated from adjacent regions by barriers or a change in environmental conditions which limits the movement of species or prevents their establishment outside their natural geographical range.

Biota
Any living organisms, both animals and plants.

Biotope
The physical "habitat" with its biological "community"; a term which refers to the combination of physical environment (habitat) and its distinctive assemblage of conspicuous species. MNCR uses the biotope concept to enable description and comparison.

The smallest geographical unit of the biosphere or of a habitat that can be delimited by convenient boundaries and is characterised by its biota (Lincoln, Boxhall & Clerk 1982).

Boreal
(Biogeographical) Pertaining to cool or cold temperate regions of the northern hemisphere. In marine zoogeographical terms, Ekman (1953) states that the centre of the Boreal region lies in the North Sea. It is bounded by the subarctic transitional zone to the north between Shetland, the Faroe Islands and Iceland, and in the south west of Britain by a transitional zone with the Mediterranean-Atlantic Lusitanean region.

Catadromous (of fish)
Downward-running: spending most of their life in rivers and migrating downstream to the sea in order to breed (eg eels) (cf. "anadromous").

Coastal zone
The space in which terrestrial environments influence marine (or lacustrine) environments and vice versa. The coastal zone is of variable width and may also change in time. Delimitation of zonal boundaries is not normally possible; more often such limits are marked by an environmental gradient or transition. At any one locality, the coastal zone may be characterised according to physical, biological or cultural criteria, which need not, and rarely do, coincide.

Cobble
A rock particle defined in two categories based on Wentworth (1922): large (128-256 mm); small (64-128 mm) (from Hiscock 1990).

Common Fisheries Policy (CFP)
A 20-year programme agreed in 1983 by EC Member States for the management and conservation of fish stocks, the maintenance and improvement of the market structure associated with the fishing industry, and international fisheries agreements.

Continental shelf
The seabed adjacent to a continent to depths of around 200 metres, or where the continental slope drops steeply to the ocean floor. Defined in law as "the seabed and subsoil of the submarine areas adjacent to the coast… to a depth of 200 metres"; the legal landward limit is set at the outer limit of territorial waters (q.v.) (Geneva Conference on the Law of the Sea, Convention on the Continental Shelf, 1958).

Controlled waters
In the UK, for the purposes of pollution control and other regulations, all rivers, streams, lakes, groundwaters, estuaries and coastal waters to a distance of three nautical miles (5.5 km) offshore (12 nautical miles (22 km) for migratory fish). The term is also used to refer to the area extending to 200 km from baselines (or to the midline between countries where less than 200 km) where a country has rights in relation to utilisation of resources and control of pollution but where the area is not described as an "Exclusive Economic Zone" (q.v.).

Current
Horizontal movement of water in response to meteorological, oceanographical and topographical factors (see also "tidal stream") (from Ministry of Defence 1987); a steady flow in a particular direction. "Current" refers to residual flow after any tidal element (ie tidal streams) has been removed.

Demersal
Living at or near the bottom of a sea or lake, but having the capacity for active swimming.

Diadromous
Fish that spend part of their life in freshwater and part in saltwater; eg anadromous salmon and catadromous eels.

Ebb tide
Outgoing or falling tide.

Ecosystem
A community of organisms and their physical environment interacting as an ecological unit (from Lincoln, Boxhall & Clerk 1982). Usage can include reference to large units such as the North Sea down to smaller units such as kelp holdfasts as "an ecosystem".

Ecosystem approach
The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way (Convention on Biological Diversity). There have been various elaborations on the definition, eg in a marine context as "the comprehensive integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of the marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity" (definition being discussed under the developing EU Marine Strategy).

Eddy
Motion of a fluid in directions differing from, and at some points contrary to, the direction of the larger-scale current (from Allaby & Allaby 1990); a circular movement of water, the diameter of which may be anything from several cm to several km, caused by topographical features or sudden changes in tidal or tidal stream characteristics. (Based on Ministry of Defence 1987). Cf. "gyre".

Endocrine disruptor
An endocrine disruptor is an exogenous substance or mixture that alters the function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny, or (sub) populations.

Eustatic
Local sea-level changes deriving from global changes in sea level, which have been estimated as rising at between 1.5 and 2 mm per year.

Eutrophication
The enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned (UWWTD, 1991).

Exclusive Economic Zone (EEZ)
A legal concept introduced by the United Nations Conference on the Law of the Sea III (UNCLOS III) (1967-82), giving coastal states certain sovereign rights and jurisdictions for economic purposes over an area of sea and seabed extending up to 200 nautical miles (370 km) from a baseline (normally low-water line) (based on Baretta-Becker, Duursma, & Kuipers 1992). Cf. "controlled waters".

Flood-tide
Incoming or rising tide.

Front, frontal system
An interface between two fluid bodies with different properties (based on Baretta-Becker, Duursma, & Kuipers 1992).

Graben
A fault-bounded crustal block, generally elongate, that has been depressed relative to the blocks on either side.

Gravel
Sediment particles 4-16 mm in diameter, based broadly on Wentworth (1922), which may be formed from rock, shell fragments or maerl (based on Hiscock 1990).

Gyre
A circular or spiral motion of fluid.

Gulf Stream
A relatively warm ocean current flowing north-eastwards off the Atlantic coast of North America from the Gulf of Mexico. It reaches north eastern Atlantic waters off Europe as the North Atlantic Drift.

Igneous [rocks]
Rocks formed from molten rock (magma). They usually consist of interlocking crystals, the size of which is dependent on the rate of cooling (slow cooling gives larger crystals; rapid cooling produces smaller crystals).

Irish Sea
The area of sea between Great Britain and Ireland north of a line across St George's Channel from St Annes Head to Carnsore Point in the south, and south of a line across the North Channel from Mull of Kintyre to Fair Head in the north, including all estuaries except the Firth of Clyde (Irish Sea Study Group definition, based on Shaw (1990)).

Isostatic
Changes in sea level deriving from the effect of local crustal movements which result in Scotland rising and southern England sinking, due to the removal of the weight of ice since the last glacial period.

Lusitanean
(Biogeographical) Referring to a biogeographical region centred to the south of the British Isles and influencing the extreme south west of the British Isles.

Maerl
Twig-like unattached (free-living) calcareous red algae, often a mixture of species and including species which form a spiky cover on loose small stones - 'hedgehog stones'.

Marine
Pertaining to the sea.

Marine Nature Conservation Review (MNCR)
A project initiated by the Nature Conservancy Council (NCC) in 1987 to consolidate the information already collected on British marine ecosystems, particularly the extensive data collected from marine survey projects commissioned by the NCC since 1974, and to complete survey work and the interpretation of the data. Since 1991, the MNCR has been undertaken within the UK's Joint Nature Conservation Committee. The area included in the MNCR is the coastline of England, Scotland and Wales (excluding the Isle of Man and the Channel Isles) extending from the lower limit of terrestrial flowering plants out to the limit of British territorial seas, and into estuaries and other saline habitats to the limits of saltwater influence. The MNCR concentrates on the benthos, and is based on descriptions of habitats and the recorded abundance of conspicuous species.

Maritime
Situated, living or found close to, and having a special affinity with, the sea.

Mean Low Water Springs (MLWS)
The average of the heights of two successive low waters during those periods of 24 hours when the range of the tide is greatest (from Ministry of Defence 1980).

Mud
Fine particles of silt and/or clay, <0.0625 mm diameter (from Hiscock 1990, after Wentworth 1922). Sediment consisting of inorganic and/or organic debris with particles in this category.

Natura 2000 site(s)
The European Community-wide network of protected sites established under the Birds Directive and the Habitats Directive.

Natural Areas
A concept, introduced by English Nature, for defining areas based on their landscape features, geology and biota and resulting in the definition of 92 terrestrial and 24 coastal/maritime Natural Areas in England (English Nature 1994). Maritime Natural Areas are based on coastal cell boundaries.

Nautical Mile
A unit of distance used in navigation, equivalent to 1° of latitude. The standard, or international, nautical mile is 1852 metres; the true nautical mile changes with latitude, from 1861.7 metres at the equator to 1842.9 metres at the poles.

North Atlantic Drift
A north easterly continuation of the warm Gulf Stream current into the eastern North Atlantic.

North Sea
As defined for the purposes of the North Sea Conferences it is southwards of 62°N, eastwards of 5°W and northwards of 48° 30'N and includes the Kattegat defined by lines between coastal features (Oslo and Paris Commissions 1994 where it is described as the "Greater North Sea"). For the British coast, these are the seas to the east of Cape Wrath, and of Falmouth. This is the definition used by the JNCC for the *Directory of the North Sea Coastal Margin* (Doody, Johnson & Smith 1993) and elsewhere.

OSPAR
OSPAR (or Oslo and Paris) Commission for the Protection of the Marine Environment of the North East Atlantic. The UK is one of the sixteen contracting parties to the OSPAR convention.

Pebble
Rock particle 16-64 mm in diameter (from Hiscock 1990, after Wentworth 1922).

Pelagic zone
The open sea and ocean, excluding the sea bottom. Pelagic organisms inhabit such open waters.

Phytoplankton
Planktonic plant life: typically comprising suspended or motile microscopic algal cells such as diatoms, dinoflagellates and desmids.

Precautionary principle
A principle underlying the concept of sustainable use of resources, which implies that:
prudent action be taken in the absence of scientific certainty; the balance of the burden of proof should be to show that no irreversible harm will occur rather than to prove that significant damage will occur; environmental well-being will be given legitimate status and best-practice techniques will be developed. (From *WWF Marine Update* No. 14, April 1994.)

SAC (Special Area of Conservation)
A site of [European] Community importance designated by the [EU] Member States through a statutory, administrative and/or contractual act where the necessary conservation measures are applied for the maintenance or restoration, at a favourable conservation status, of the natural habitats and/or the populations of the species for which the site is designated (Commission of the European Communities 1992). This status is achieved by sites adopted by the European Commission.

Sand
Particles defined in three size categories based on Wentworth (1922): very coarse sand and granules (1-4 mm); medium and coarse sand (0.25-1 mm); very fine and fine sand (0.062-0.25 mm) (from Hiscock 1990).

Seagrasses
Higher plants (angiosperms) that are adapted to living submerged in seawater. They are not true grasses, but belong to the order Helobiae, and are related to pondweeds. Two genera are present in British coastal waters: *Zostera* (eelgrass) and *Ruppia*, a brackish-water genus.

SPA (Special Protection Area)
A site of European Community importance designated under the Wild Birds Directive (Commission of the European Communities Council Directive 79/409/EEC of 2 April 1979 on the Conservation of Wild Birds).

Sublittoral
The zone exposed to air only at its upper limit by the lowest spring tides. The sublittoral extends from the upper limit of the large kelps and includes, for practical purposes in nearshore area, all depths below the littoral.

Territorial waters
The seas over which a nation exercises jurisdiction and control, but within which other states have certain rights, notably for innocent passage of vessels. In UK law, the landward limit of UK territorial seas is defined as "the low water line around the coast" (Territorial Waters Order in Council 1964); the seaward limit is 12 nautical miles offshore from the landward limit.

Wentworth Scale
A scale of sediment particle size categories described by Wentworth (1922), based on a doubling above or halving below, a fixed reference diameter of 1 mm, and with descriptive class terms ranging from boulder (> 256 mm) to clay and colloid (<0.004 mm). This scale is used as the basis of the MNCR and most other sediment classifications. The Wentworth Scale is transformed to the phi (Φ) scale for statistical analysis of sediments.

Zooplankton
The animal constituent of plankton consisting mainly of small crustacea and fish larvae.

Abbreviations and acronyms

ACOPS	Advisory Committee on Protection of the Sea
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BMAPA	British Marine Aggregate Producers Association
BOD	Biological Oxygen Demand
c	(as prefix, eg cSAC) candidate
CCW	Countryside Council for Wales
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CFP	Common Fisheries Policy
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
CROW	Countryside Rights of Way Act 2001
cSAC	Candidate Special Area of Conservation
Defra	Department of Environment, Food and Rural Affairs
DoE	Department of the Environment (now subsumed by Defra)
DTI	Department of Trade and Industry
EEC	European Economic Community (later the European Community, now the European Union)
EEZ	Exclusive Economic Zone
EQS	Environmental quality standards
EU	European Union
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine environmental Protection (until about 1991, the Joint Group of Experts on the Scientific Aspects of Marine Pollution) (an advisory body to the Heads of eight organisations of the United Nations System).
GIS	Geographic Information System(s)
ICES	International Council for the Exploration of the Sea
IUCN	International Union for the Conservation of Nature and Natural Resources (now IUCN – The Conservation Union)
JNCC	Joint Nature Conservation Committee
MAFF	Ministry of Agriculture, Food and Fisheries (now subsumed by Defra)
MAGP	Multi-annual Guidance Programme
MARPOL	International Convention for the Prevention of Pollution of the Sea from Ships

MCS	Marine Conservation Society
MEHRA	Marine Environmental High Risk Area
MS	Minimum Size
MLW	Mean Low Water
MNA	Marine Natural Area
MNCR	Marine Nature Conservation Review
MSC	Marine Stewardship Council
mSPA	Marine Special Protection Area
m/g	Milligrams per litre
m/s	Metres per second
n/l	Nanograms per litre
µg/l	Micrograms per litre
NMMP	National Marine Monitoring Programme
NVZ	Nitrate Vulnerable Zone
OSPAR	Oslo and Paris Convention (short title for the 1992 International Convention for the Protection of the Marine Environment of the North-East Atlantic).
PAHs	Poly-cyclic Aromatic Hydrocarbons
PCBs	Poly-chlorinated biphenyls
Ro-Ro	Roll on - Roll off ferry
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SFC	Sea Fisheries Committee
SMRU	Sea Mammal Research Unit
SNH	Scottish Natural Heritage
SPA	Special Protection Area
STW	Sewage treatment Works
TAC	Total Allowable Catch
TBT	Tri-butyl tin
UWWTD	Urban Waste Water Treatment Directive
W& C Act	Wildlife and Countryside Act 1981

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Top left: Otter trawler hauling catch. North Eastern Sea Fiisheries Committee
Bottom left: Seawater surface for all the Natural Areas in June 1997. © Natural Environment Research Council (NERC) & Plymouth Marine Laboratory (PML) 2004
Main: Grey seal basking on rock; 75% of England's population are found within this Natural Area. JNCC

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